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Editorial

Permeability at Very High Frequencies

EXPERIMENTS have been made from time to time to determine the relation between the permeability μ of iron and other magnetic metals and the frequency. In 1899 Drude showed that at the frequency of light (3×10^{14}) iron and nickel appeared to be non-magnetic, that is to say, to have unit permeability. Subsequent experiments by various workers indicated that the permeability decreased slowly as the frequency was increased up to about 10^9, and then fell rapidly to unity in the range $10^9 - 10^{11}$.

At first sight one might fear that the measurements of permeability would be vitiated by eddy currents or skin-effect screening the interior of the metal from the magnetic field, but since skin-effect depends upon permeability it can be employed to determine the value of the permeability. If two thermo-ammeters are connected in series, one of which has a heater of non-magnetic material, whilst the other has a heater of iron or nickel, their relative calibration will vary with the frequency. The effective resistance of the non-magnetic heater can be calculated from its diameter, its specific resistance and the frequency, whereas the effective resistance of the magnetic heater depends also on its permeability. Since the readings of the ammeters depend on the temperatures of the heaters, which, for the same current, depend on their effective resistances, it is obvious that the permeability can be determined from the readings. An interesting account of such experiments is given by Möhring in *Hochf:tech. u. Elek:akus.* of June, 1939. Vacuum thermo-ammeters were constructed with heaters of iron and nickel wires 4 mm. long and of 38μm diameter. The thermo-junctions were not in actual contact with the heaters but were insulated therefrom by a small bead of glass, the capacitance being less than $1\ \mu\mu F$. As an added precaution a magnetic thermo-ammeter was connected between two non-magnetic instruments and the distances between them made as small as possible to eliminate errors due to capacitance currents. The frequency range employed was from 100,000 to 150×10^6 cycles per second.

Even if one assumes that the permeability is constant throughout the material and throughout the cycle, the calculation of the high-frequency resistance of a straight wire of circular cross-section involves Bessel functions, but there are two limiting cases that lend themselves to simple approximate calculation, viz. when the skin-effect is relatively small, and when it is so great that the penetration is small. It can be shown* that when the penetration is very small the power dissipated is the same as it would be if the current were uniformly distributed over a surface layer of thickness $t = 1/\beta$ where

* See Howe, *Journ. I.E.E.*, 54, p. 475. 1916.

$\beta = 2\pi\sqrt{\frac{f\mu}{10^9\rho}}$. This leads simply to the formula $R_f/R_0 = 0.5\beta r + 0.25$ where r is the radius of the conductor (*loc. cit.*

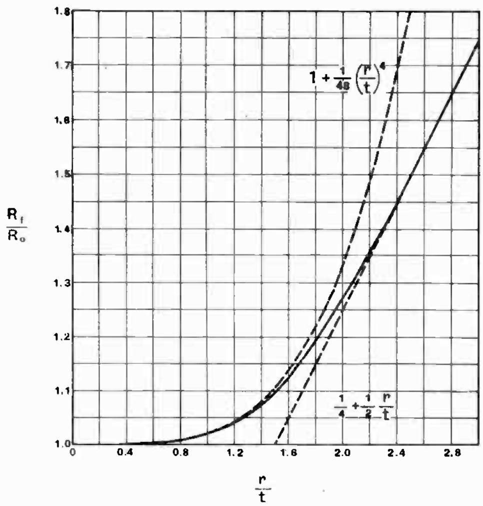


Fig. 1.

equation (5)). As the penetration increases this formula becomes less accurate and should not be used if $t > r/2$. If $t = r/2$, the formula

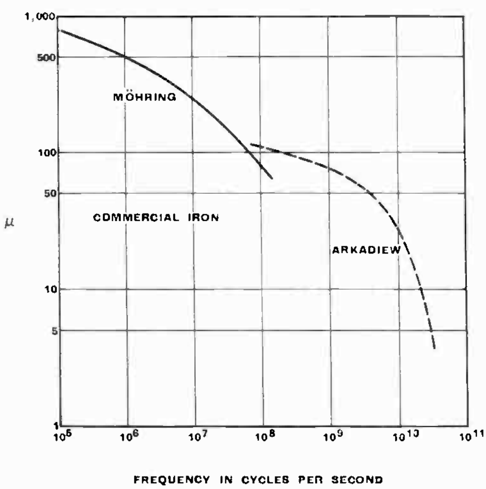


Fig. 2.

gives $R_f/R_0 = 1.25$, whereas the accurate value is 1.27.

In the other case, when the skin-effect is small

$$R_f/R_0 = 1 + \frac{1}{48}\left(\frac{r}{t}\right)^4,$$

but this cannot be used if $t < r/2$. If $t = r/2$ this formula gives $R_f/R_0 = 1.33$ instead of 1.27.

Fig. 1 shows the accurate curve and the two approximations; it is seen that one or the other of the latter gives a very close approximation except for values of r/t between 1.3 and 2.3.

The results obtained for commercial iron are shown in Fig. 2. A rough exterpolation indicates that μ would fall to unity at about 4×10^{10} cycles per second which agrees as closely as could be expected with the results obtained by Arkadiew.

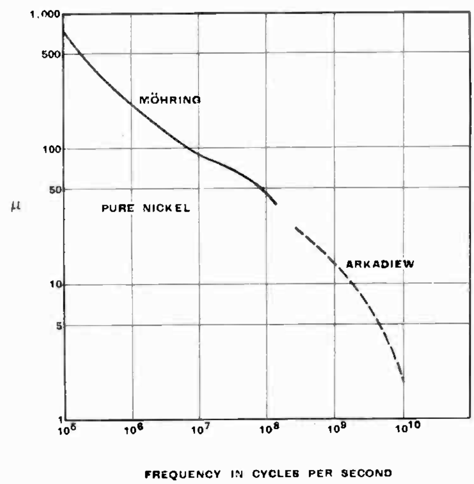


Fig. 3.

Fig. 3 shows the results obtained for pure nickel; the dotted curves show results obtained by Arkadiew.

The author also found that at a constant frequency the permeability increased with the current, thus with the iron wire at 12.4×10^6 cycles per second an increase in the current from 60 to 80 mA gave an increase of μ from 180 to 230; under similar conditions the nickel wire gave an increase of μ from 25 to 39.

There appears to be no doubt that iron and nickel lose their special magnetic properties when the frequency reaches a value somewhere between 10^9 and 10^{11} cycles per second.

G. W. O. H.

Signal Handling Capacity of H.F. Valves*

A Method of Measurement

By R. W. Sloane, M.A., Ph.D.

(Communication from the Research Staff of the M.O. Valve Company, Limited, at the G.E.C. Research Laboratories, Wembley, England)

Introduction

THE curvature of the characteristics of valves in R.F. and I.F. stages of radio receivers causes distortion of the modulation envelopes of received signals. The "signal handling capacity" of an H.F. valve is the carrier frequency voltage at the grid, which produces a carrier frequency anode current, the modulation envelope of which is distorted in some way acknowledged to be just permissible.

This value of grid voltage may be deduced[1], laboriously, from the families of static characteristics of the valve, or it may be measured, if the necessary apparatus is available. The usual method of measurement involves the production of a modulated carrier, with a very pure sine-wave modulation, and the analysis of the harmonics in the modulation envelope of the carrier frequency anode current.

The object of the work reported in this article was to develop a method of measuring signal handling capacity which would be simple and speedy and would require comparatively little special apparatus.

Principle of Operation

It is easy to prove (see Appendix) that the distortion of the modulation envelope, due to the curvature of the valve characteristic, is related to the production of third harmonic of the carrier. A measurement of the third harmonic of an unmodulated carrier may, therefore, be substituted for the measurement of modulation distortion. Considerable simplification of the apparatus results, because the need for pure sine-wave modulation of a carrier, and for perfectly linear detection, is avoided.

The apparatus described in this article was developed from the following simple ideas.

Suppose that $100T$ per cent. third harmonic of an unmodulated carrier corresponds to the chosen signal handling criterion. Then suppose that the valve under test has, in its anode lead, a load of resistance R_1 ohms at the fundamental frequency, and zero at all other frequencies, and, in series with the first, another load having resistance R_3 ohms at the third harmonic frequency and zero at all other frequencies. If R_1 and R_3 be adjusted so that $R_1 = TR_3$, then the voltages across the two loads are equal when the signal handling condition is satisfied. The input is varied until an indicator shows that the voltages *are* equal, and then the input voltage, which is the signal handling capacity, is read directly.

Description of Apparatus

The apparatus, which is designed to operate with a signal frequency of 10 kc/s, is shown schematically in Fig. 1. The signal is purified by the low-pass filter L, measured

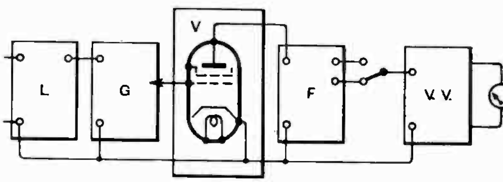


Fig. 1.

by a thermal meter and attenuator, and conveyed to the grid of the valve under test by a transformer, in the circuit G. The valve under test, V, is followed by a circuit, F, which makes it possible to measure the total output and the third harmonic voltages separately on the valve voltmeter $V.V.$ Most of the circuit is detailed in Fig. 2, so the following remarks are sufficient to complete the description.

* MS. accepted by the Editor, April, 1939.
[1] *Phil Mag.*, 1937, Ser. 7, Vol. 23, p. 529.

(a) Attenuator

The resistances R_1, each of 10 ohms, and R_2, each of 2 ohms, are connected to form a Kelvin-Varley attenuator. As the impedance of the transformer primary is large compared with 100 ohms, the low-pass filter, C_1, L_1, C_2, is terminated in its characteristic impedance of 100 ohms for all settings of the attenuator. The output circuit of the generator is also matched to the 100-ohm filter.

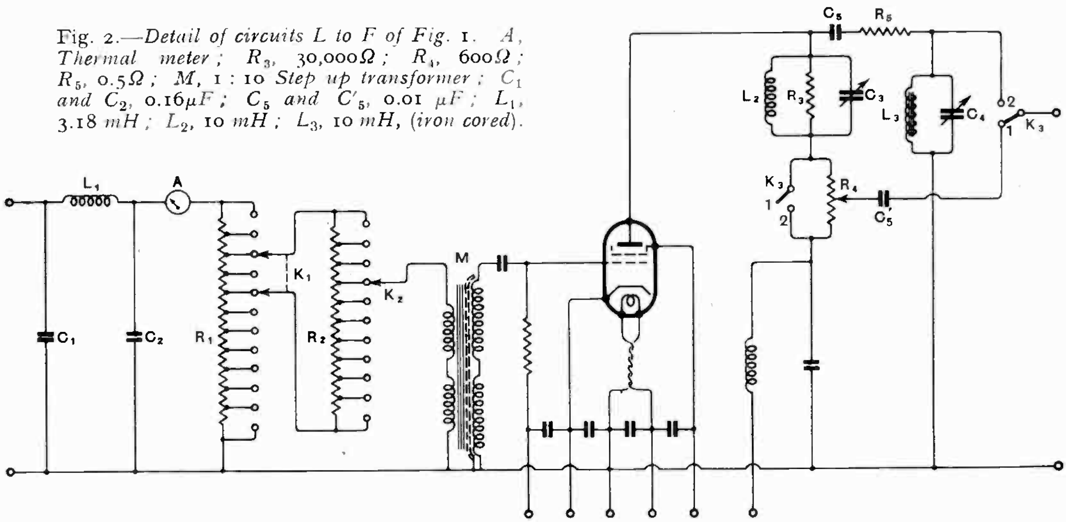


Fig. 2.—*Detail of circuits L to F of Fig.* 1. *A, Thermal meter;* R_3, 30,000Ω; R_4, 600Ω; R_5, 0.5Ω; *M,* 1 : 10 *Step up transformer;* C_1 *and* C_2, 0.16μF; C_5 *and* C'_5, 0.01 μF; L_1, 3.18 *mH;* L_2, 10 *mH;* L_3, 10 *mH, (iron cored).*

When a current of 7.1 milliamperes R.M.S. flows through the meter A, there is 1 volt peak across the attenuator. The positions of K_1 and K_2 then give the output voltage of the attenuator in tenths and hundredths of a volt peak.

(b) Supplies to valve under test

Four valve holders are wired in parallel, to provide for the test of most current types of H.F. valves.

(c) Anode circuit

The total alternating current, which is approximately equal to the fundamental current, is measured by the voltage it produces across part of the resistance R_4 when the ganged switches K_3 are in position 1. When the switches are in position 2, the valve voltmeter measures the third harmonic voltage across the circuit L_3, C_4. Both the circuits L_2, C_3 and L_3, C_4 are tuned to 30 kc/s and R_5 is a high resistance, so voltages of frequencies other than the third harmonic are highly attenuated. The discrimination of this crude filter in favour of 30 against 10 kc/s was found to be better than 1,400 : 1. The value of R_3 is chosen to make the dynamic resistance of the circuit L_2, C_3 small compared with the anode A.C. resistance of any valve likely to be tested.

Different settings of R_4 give different ratios of third harmonic to total current for equality of output voltage, so correspond to different signal handling criteria.

(d) Valve voltmeter

In the mains operated valve voltmeter a two stage amplifier precedes a diode detector and triode D.C. amplifier. The output is read on a milliamperemeter in the anode circuit of the triode. It was checked that the ratio of 30 kc/s voltage to 10 kc/s voltage to produce the same output in the valve voltmeter did not vary with the amplitudes of these voltages or with the setting of the sensitivity control of the voltmeter.

Calibration

To calibrate the scale of R_4, valves, the signal handling capacity of which had been deduced by a graphical method [1], were used as standards. The procedure was as follows:

(i) One of the standardised valves was set up in the test position, all electrode voltages being the same as those used for the graphical measurement.

(ii) The attenuators R_1 and R_2 were set to give a 10 kc/s input, to the valve, equal to the signal handling capacity.

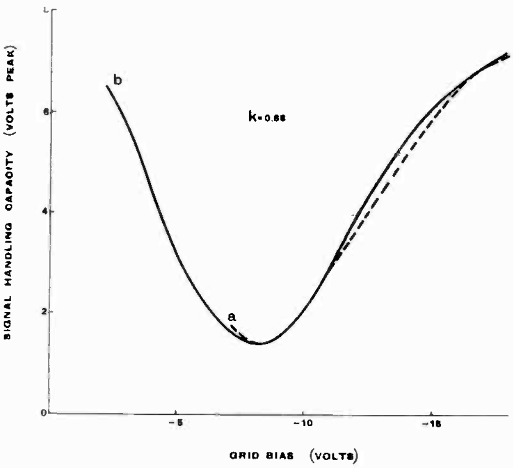


Fig. 3.—*Signal handling capacity of a VMP4G. V_a = 250v, V_s = 100v. (a) by the graphical method. (b) by the apparatus.*

(iii) The potentiometer setting, R_4, was varied, while K_3 was switched between positions 1 and 2, until there was no change of valve voltmeter reading on switching.

(iv) This position of R_4 was marked with a number, k, characteristic of the signal handling condition adopted for the graphical measurement.

This process was repeated for different values of k and for different valves. The positions of R_4 for the same value of k agreed closely from valve to valve. The mean for all the valves was marked on the permanent scale.

Figs. 3 and 4 illustrate how closely the values for individual valves approach the mean used in the calibration.

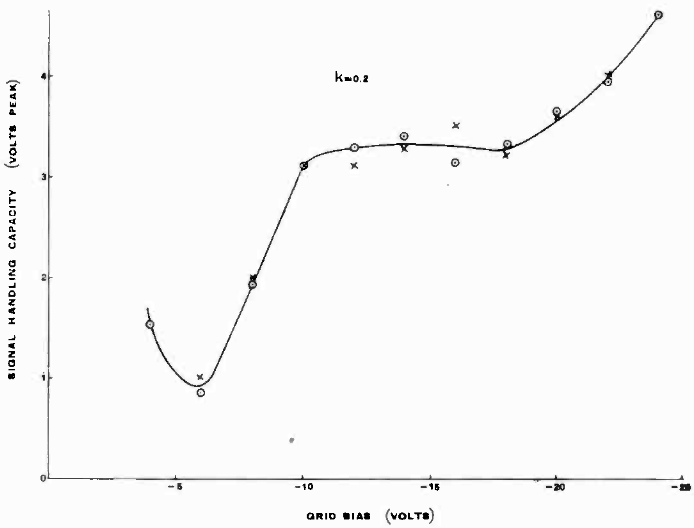


Fig. 4.—*Signal handling capacity of a KTW 61. V_a = 250v, V_s = 80v. Crosses by the graphical method. Circles by the apparatus.*

In all measurements made in connection with the calibration, screen potentials were kept fixed, independent of grid bias, in order to avoid unnecessary complication of the graphical method.

It would have been possible to calibrate the apparatus by applying, in turn, 10 kc/s and 30 kc/s voltages to the input and adjusting them to give the same output, but this would have involved the removal of the input filter, the provision of means for measuring very small 30 kc/s voltages and elaborate screening of the circuit L_3, C_4. No improvement in accuracy could be expected from this method, as the third harmonic current is, in fact, not compared with the fundamental, but with the total current.

Measurement Procedure

The use of the apparatus may be reduced to the following simple routine.

(i) Set the potentiometer, R_4, to the required signal handling criterion. The setting is found from the formulae 2 or 3 in the Appendix, or from Fig. 5. For instance, if the condition is 5 per cent. second harmonic of the modulation at 60 per cent. modulation, the reading on the potentiometer dial is 0.27, as shown by the dotted lines in Fig. 5.

(ii) Set the current into the attenuator to 7.1 milliamperes R.M.S., to make the attenuator read peak volts.

(iii) With K_3 in position 2, tune C_3 and C_4 to give maximum output on the valve voltmeter.

(iv) Vary the attenuator setting, while switching K_3 between positions 1 and 2, until there is no change of valve voltmeter reading on switching.

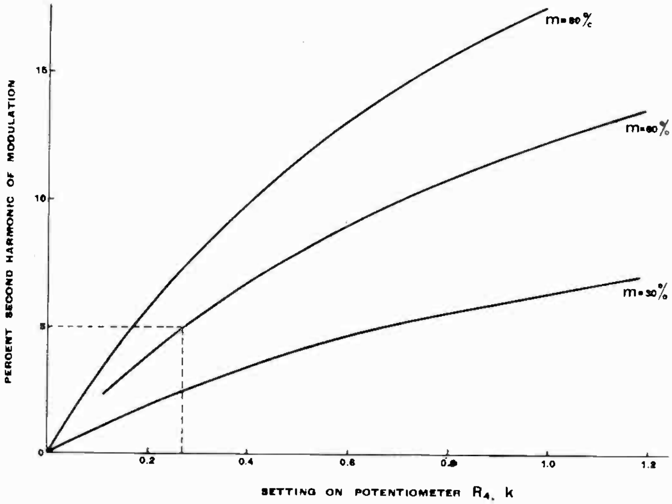


Fig. 5.

(v) Read the signal handling capacity, shown in peak volts by the attenuator.

(vi) Repeat (iv) and (v) for all relevant values of electrode voltages of the valve under test.

The supplies to the valve under test are usually obtained from a valve table. If, under working conditions, the D.C. potentials, of anode or screen, or both, vary with grid bias, resistances should be inserted in the supply leads, so that practical conditions are reproduced. (The by-passing condensers are in the apparatus itself.)

Conclusion

The measurement of signal handling capacity has been rendered almost as easy as the plotting of a static characteristic. The apparatus itself is comparatively simple, and only the test stage is restricted in application to the particular measurement, the generator and valve voltmeter being available for other purposes.

Complications in the working conditions of the valve, such as resistances in supply leads, do not increase the work involved in the measurement.

The accuracy of results obtained from the apparatus depends on the accuracy of equation (1) of the Appendix as a representation of the valve characteristic. As a rough guide, it may be said that the method is quite accurate whenever the fifth harmonic of the carrier in the anode current is small compared with the third.

It is assumed that the anode A.C. resistance of the valve under test is very high. The method takes no account of the drop in anode resistance which may take place at the low voltage end of large excursions of the anode voltage.

Acknowledgments

In conclusion the author desires to tender his acknowledgments to The General Electric Company Limited and the Marconiphone Company, on whose behalf the work was done which has led to this publication.

APPENDIX

The anode current of a screen-grid valve, under normal working conditions, depends on the grid voltage only, because the anode A.C. resistance is very high and the screen potential is constant.* The change, i, in anode current, due to a change, v, of grid voltage, may be represented by an equation of the form

$$i = av + bv^2 + cv^3 + dv^4 \qquad \qquad (1)$$

where a, b, c and d are constants over the range of grid voltage occupied by any one signal. When the change of grid voltage is a modulated signal,

$$v = e(1 + m\cos pt)\cos \omega t,$$

then the modulation envelope of the fundamental component of anode current is

$$\begin{aligned}&[ae + \tfrac{3}{4}ce^3(1 + \tfrac{3}{2}m^2)]\\ &+ [aem + \tfrac{9}{4}ce^3m(1 + \tfrac{1}{4}m^2)]\cos pt\\ &+ \tfrac{9}{8}ce^3m^2\cos 2pt\\ &+ \tfrac{3}{16}ce^3m^3\cos 3pt.\end{aligned}$$

If†

$$k = 3\frac{c}{a}e^2$$

then the distortion of the modulation envelope is completely specified by the value of k and the value of m. For example, the percentage of second har-

* The screen potential may vary with the steady bias on the grid, but does not vary at signal frequency.

† This is the same as the definition of k in the graphical method of reference (1).

monic in the modulation is

$$100\,s = \frac{\frac{3}{8}mk}{1 + \frac{3}{4}(1 + \frac{1}{4}m^2)k} \,.\, 100 \quad .. \quad .. \quad (2)$$

and the modulation depth has been multiplied by a factor

$$M = \frac{4 + 3k\left(1 + \frac{m^2}{4}\right)}{4 + k\left(1 + \frac{3m^2}{4}\right)} \quad .. \quad .. \quad (3)$$

If an unmodulated signal,

$$v = e \cos \omega t$$

be applied to the grid of the same valve, the amplitude of the fundamental component of anode current is

$$ae + \tfrac{3}{4}ce^3$$

and the amplitude of the third harmonic component is

$$\tfrac{1}{4}ce^3$$

so the percentage of third harmonic is

$$100\,T = \frac{\frac{1}{12}k}{1 + \frac{1}{4}k} \,.\, 100 \quad .. \quad .. \quad (4)$$

By equation (4), for a given value of T, there is a corresponding value of k, so the potentiometer, R_4, of Fig. 2, may be calibrated in units of k. The signal handling condition, represented by a particular value of k, may be expressed in terms of distortion and modulation depth by equation (2) or (3). The family of curves given by equation (2) is plotted in Fig. 5.

The Wireless World

FOR our sister journal *The Wireless World* to have continued as a weekly publication during the present struggle would, it was feared, have introduced some risk of a falling-off in the standard which the journal has set itself. It has therefore been decided that *The Wireless World* shall, for the duration of the war, appear monthly in an enlarged form at the price of one shilling. The first monthly issue, dated November, was published on October 20th. Thereafter issues will be published on the 20th of each month. Readers are asked to place an order with their newsagents or a subscription (14/- per annum) with the Publishers, Dorset House, Stamford Street, London, S.E.1.

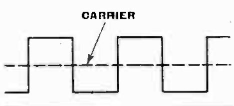
Lanchester's "Potted Logs," Parts I and II

By F. W. LANCHESTER, F.R.S. 27 Pp. Taylor and Francis, Ltd., Red Lion Court, Fleet Street, London, E.C.4. Price 2s.

This table enables one with the aid of a slide-rule to evaluate the logarithm to seven places of decimals of numbers running to seven or eight figures. The author states that "a straight table of logarithms of equal capacity would occupy about fifty goodly tomes and require a wheel-barrow for its transport." The table only occupies five pages and constitutes Part I. Part II deals with natural logarithms and the musical scale. We feel sure that this little booklet will be of great service to those who require such accurate logarithms. G. W. O. H.

Frequency or Phase Modulation?

THERE was recently some correspondence in the columns of *The Wireless World** concerning the correct description of a system of modulation introduced by Armstrong, one writer referring to it as "frequency or, as it is sometimes called, phase modulation," and others writing to prove mathematically that they are really the same or really different. If, instead of sinusoidal modulation, one assumes rectangular modulation, that is, something approaching what would with ordinary amplitude modulation be represented by the diagram, the essential difference between the two is brought out very clearly.



If phase modulation is being employed, the sudden jumps should correspond to sudden changes of phase, i.e. the rotating vector should *spring suddenly* forward or backward, but, having sprung, should then continue to rotate at the same speed as before; if it does not, then the frequency has also been modulated.

If on the other hand frequency modulation is being employed, the vector undergoes no sudden displacement but merely changes its angular velocity, rotating successively at speeds above and below that of the unmodulated carrier by definite amounts. It is, of course, a necessary consequence of the higher frequency that the phase advances, since the vector at any moment is in advance of the position that it would have otherwise occupied. This is no reason, however, for confusing it with phase modulation, since it is the frequency that depends directly on the depth of modulation and undergoes the sudden changes in the case illustrated; the gradual change of phase is a secondary phenomenon. To decide whether any actual practical case is the one or the other, it is only necessary to ask what happens to the rotating vector if the output is modulated rectangularly. G. W. O. H.

* June 15th and 29th, and July 20th, 1939.

Diode Operating Conditions*

By W. P. N. Court, B.Sc.(Eng.), A.C.G.I.

Part I.—Diode Rectifier Alone

Measurement of Diode Characteristics

SUPPOSE the diode is connected in series with two sources of E.M.F., one alternating and the other direct, as shown in Fig. 1—each source being assumed to have negligible impedance to both alternating and direct currents—then a family of characteristics may be plotted showing the relation between the mean current i_0 in the diode and the direct voltage v_a, with $\hat{e}$, the alternating input voltage amplitude, as parameter.

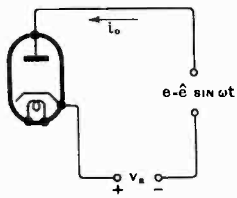


Fig. 1.—*Circuit for measuring diode characteristics.*

These characteristics are shown in Fig. 2. Each characteristic will cut the v_a axis at a point distant from the origin O by an amount $\hat{e}$ corresponding to that characteristic, since i_0 is zero for values of v_a equal to or greater than that amount.

Resistive Load—Unmodulated Input

In Fig. 3 the direct voltage v_a is shown replaced by a bias voltage e_b in series with a voltage drop $v_0 = R_2 i_0$ set up across a load resistance R_2 by the passage of i_0. R_2 is shunted by a condenser C_2 of sufficient size to have negligible impedance at the input frequency.

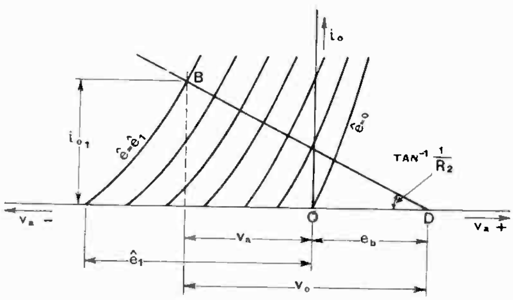


Fig. 2.—*Diode characteristics.*

The applied voltages to the diode are now $v_a = (v_0 + e_b)$ and $\hat{e}\sin\omega t$. The value of i_0 for a particular value of peak input $\hat{e}_1$ may now be found, from Fig. 2, by the intersection of the characteristic corresponding to $\hat{e}_1$ and a straight line BD, whose slope is $\frac{1}{R_2}$.

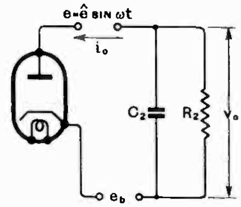


Fig. 3.—*Practical diode circuit.*

The construction and interpretation of this load line BD should be clear from the diagram, which is drawn for the case of positive bias.

If current does not cease to flow in the diode until a negative voltage is applied—a practical consideration—this voltage may be considered as a positive bias and added to e_b when drawing the load line.

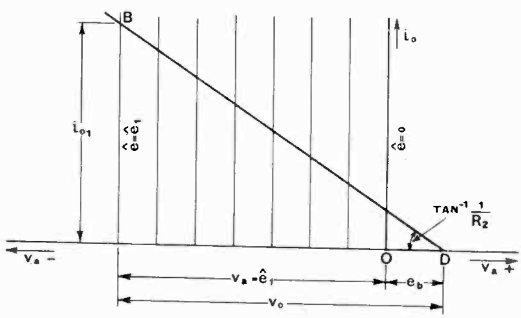


Fig. 4.—*Approximate diode characteristics.*

If the resistance R_2 is very large the line BD will approach the v_a axis and a close approximation to the conditions obtaining may be made by assuming the characteristics to be vertical straight lines as shown in Fig. 4. To this degree of approximation v_a now equals $\hat{e}_1$.

In order to simplify the analysis this approximation is made throughout in what follows.

Resistive Load—Modulated Input

Suppose now the input is modulated and of the form $e_1 = \hat{e}_1\ (1 + m_a \sin nt) \sin \omega t$,

* MS. accepted by the Editor, July, 1939.

and that the condenser C_2 has infinite impedance at the modulation frequency.

If $\omega \gg n$ — i.e., if the change of amplitude during a single carrier frequency period is negligible—then the value of i_0 corresponding to any point on the input peak envelope may be found by the intersection of the load line BD and the characteristic corresponding to the value of $\hat{e}_1$ $(1 + m_a \sin nt)$ at that point. Thus i_0 will alternate at the modulation frequency about a mean value corresponding to $\hat{e}_1$.

If the load line BD cuts the i_0 axis, modulation up to 100 per cent. may be accepted without distortion, since i_0 never becomes zero for any value of e_1. If, however, BD does not cut the i_0 axis the acceptable modulation is limited. This occurs

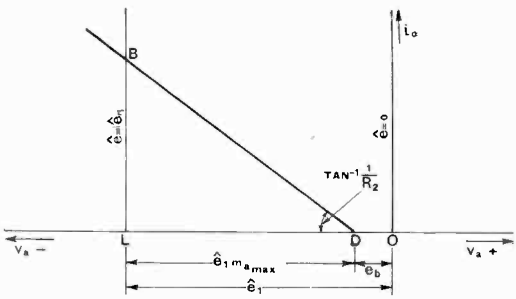


Fig. 5.—*Load line with negative bias.*

when negative bias is applied and it is obvious from Fig. 5 that the maximum acceptable mod. depth

$$= \frac{DL}{OL}$$

$$= \left[1 - \frac{e_b}{\hat{e}_1}\right] = \frac{1}{\alpha}.$$

Resistive Load—Modulated Input—Indirect Coupling

If the modulation output voltage across the diode load is transferred indirectly to the succeeding valve by means of a condenser C_3 and a resistance R_3 tapped down the load, as shown in Fig. 6, then distortion may occur for large values of m_a. For, supposing C_3 to have zero impedance at the modulation frequency, the effective load impedance at this frequency is $R_e = R_2\left[1 - \dfrac{p^2R_2}{R_3 + pR_2}\right]$, where p is the ratio of tap to full resistance.

Thus for the changing carrier a new load line must be drawn whose slope is equal to $\dfrac{1}{R_e}$. Now, since C_3 is assumed to have negligible impedance, the load at the modulation frequency is purely resistive and the output voltage across the load will be in phase with the peak envelope of the diode input. Hence the output voltage will pass through its mean value at the same instant as the input envelope, and at this instant the input amplitude is that of the carrier alone. Thus this new load line must pass through the point B in Fig. 7, corresponding to the unmodulated carrier, and cuts the v_a axis in point C.

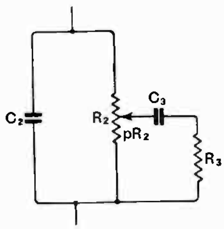


Fig. 6.—*Indirect coupling.*

In Fig. 7 a case is shown where BC does not cut the i_0 axis and hence the acceptable mod. depth without distortion is limited, and it is clear that :—

max. acceptable mod. depth

$$= \frac{CL}{OL} = \frac{R_e}{R_2} \times \frac{(\hat{e}_1 + e_b)}{\hat{e}_1}$$

$$= \frac{R_e}{R_2} \times \frac{1}{\alpha}.$$

Reactive Load—Modulated Input

At the higher modulation frequencies the condenser C_2 may have an impedance com-

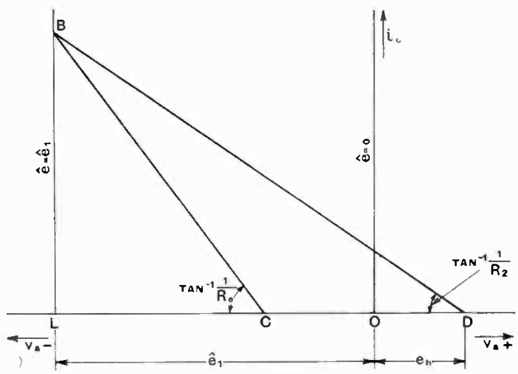


Fig. 7.—*Load line for indirect coupling.*

parable with R_2 instead of being infinite as hitherto assumed.

When this occurs the load line for the changing carrier is no longer a straight line but an ellipse. Distortion will occur if the ellipse cuts the v_a axis.

From Fig. 8 it can be seen that if a sinusoidal voltage, $e_{1m} = m_d \hat{e}_1 \sin nt = \hat{e}_{1m}$

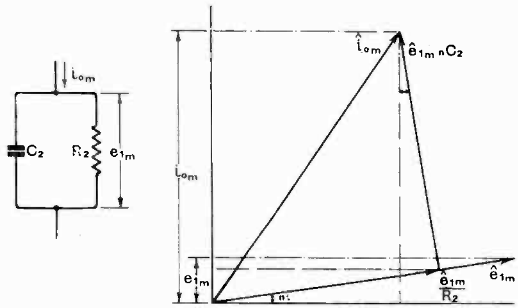


Fig. 8.—*Vector diagram for reactive load.*

$\sin nt$ is set up across the load the instantaneous current in the load is given by :—

$$i_{0m} = \hat{e}_{1m}\left[\frac{1}{R_2}\sin nt + nC_2 \cos nt\right]$$

$$= \frac{e_{1m}}{R_2} \pm nC_2(\hat{e}_{1\,m}^{\,2} - e_{1\,m}^{\,2})^{\frac{1}{2}}.$$

The method of drawing the ellipse should be obvious from this expression and Fig. 9.

The calculation of the max. acceptable mod. depth, without distortion, proceeds as follows :—

$$i_{0m} = \frac{e_{1m}}{R_2} + nC_2(\hat{e}_{1\,m}^{\,2} - e_{1\,m}^{\,2})^{\frac{1}{2}},$$

— the positive sign being taken to find max. i_{0m}—

$$\therefore \frac{di_{0m}}{de_{1m}} = \frac{1}{R_2} - \frac{nC_2 \times e_{1m}}{(\hat{e}_{1\,m}^{\,2} - e_{1\,m}^{\,2})^{\frac{1}{2}}} = 0,$$

for a critical value,

$$\text{or,}\quad e_{1m} = \frac{\hat{e}_{1m}}{(1 + n^2C_2^{\,2}R_2^{\,2})^{\frac{1}{2}}},$$

$$\text{when}\quad i_{0m} = \hat{i}_{0m} = BL.$$

Hence, substituting in expression for i_{0m} :—

$$\hat{i}_{0m} = \frac{\hat{e}_{1m}}{R_2} \times (1 + n^2C_2^{\,2}R_2^{\,2})^{\frac{1}{2}} = \frac{LD}{R_2}$$

$$\text{Now,}\quad OL = \hat{e}_1 = LD - e_b$$

$$\therefore \hat{e}_{1m} = \frac{(\hat{e}_1 + e_b)}{(1 + R_2^{\,2}n^2C_2^{\,2})^{\frac{1}{2}}} = m_{d\,\max} \times \hat{e}_1.$$

$\therefore$ max. acceptable mod. depth

$$= \frac{1}{\alpha} \times \frac{1}{(1 + R_2^{\,2}n^2C_2^{\,2})^{\frac{1}{2}}}.$$

If indirect coupling is used the ellipse is drawn about the load line BC of slope $\frac{1}{R_e}$ and the max. acceptable mod. depth

$$= \frac{R_e}{R_2} \times \frac{1}{\alpha} \times \frac{1}{(1 + R_2^{\,2}n^2C_2^{\,2})^{\frac{1}{2}}}.$$

It would appear from the above that in all cases where the acceptable mod. depth without distortion is limited this depth may be raised to unity by suitable choice of α—i.e., by the use of positive bias. As will be shown in Part II the practical difficulty lies in the finite impedance of the source, which has hitherto been considered to be zero.

Part II.—Rectifier and Tuned Circuit

Rectifier Current for Sinusoidal Applied Voltage

It has been shown that the current flowing into a diode rectifier, on application of a

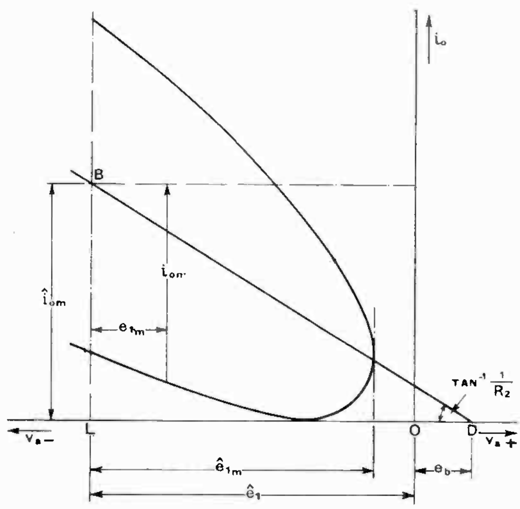


Fig. 9.—*Load line for reactive load.*

sinusoidal E.M.F., consists of unidirectional pulses. This current may be split up by Fourier analysis into a steady component, a component at the fundamental frequency and a series of components at harmonic frequencies.

Thus :— $i_R = i_0 + \hat{\imath}_1 \sin \omega t + \hat{\imath}_2 \sin (2\omega t + \theta) + \ldots .$

The amplitude of the component at the fundamental frequency is equal to $\frac{\hat{e}_1}{R}$ — where $\hat{e}_1$ is the applied E.M.F. and R is the effective input resistance of the rectifier

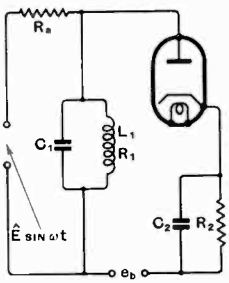


Fig. 10.—*Practical diode circuit.*

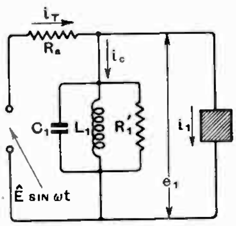


Fig. 11. — *Circuit equivalent to Fig.* 10.

Now it has been shown by several writers that $R \simeq \frac{R_2}{2K}$, where $K = \frac{v_0}{\hat{e}_1} = \frac{R_2 i_0}{\hat{e}_1}$.

$$\therefore \quad \hat{\imath}_1 = \frac{\hat{e}_1}{R} \simeq \frac{\hat{e}_1}{R_2/2} \times \frac{R_2 i_0}{\hat{e}_1} = 2i_0.$$

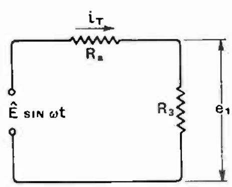
Hence, for a given sinusoidal input E.M.F. to the rectifier, the amplitude of the fundamental component of current flowing in the diode is very nearly equal to twice the value of the mean D.C.

The harmonic and steady components of the current take no power from the source and hence do not affect R.

Rectifier Shunted across Tuned Circuit.

We now consider the rectifier in parallel with a tuned circuit, the combination being

Fig. 12. — *Circuit equivalent to Fig.* 11, *for fundamental frequency current only. Neglecting reactance of* C_1 *and* C_2.



connected in the anode circuit of a valve of slope resistance R_a. Fig. 10 shows the form of the circuit, which may be replaced by the equivalent shown in Fig. 11, where $R_1{}^1 = \frac{\omega^2 L_1{}^2}{R_1}$.

In order, initially, to simplify the analysis and make the mechanism clear, the following assumptions are made.

(*a*) The steady and harmonic components of the rectifier current find paths of zero impedance, in the tuned circuit, for their return to the rectifier.

(*b*) Over the sideband range to be considered the tuned circuit has a constant impedance—the resistance R_1'.

(*c*) Over the range of modulation frequencies to be considered the condenser C_2, across the diode load, has infinite impedance.

(*d*) The diode characteristics are those assumed in Part I.

With the above characteristics, when $e_b = 0$, $v_a = \hat{e}_1 = v_0$, and hence $K = 1$, and $R = \frac{R_2}{2}$.

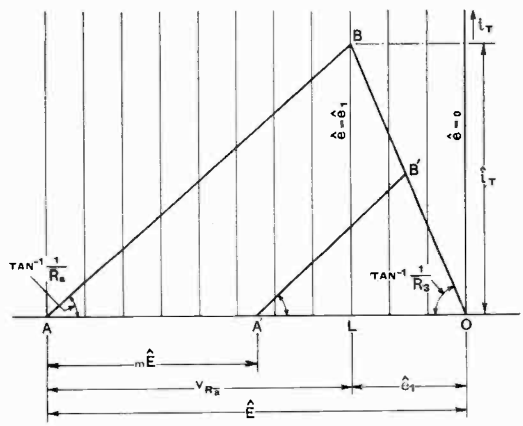


Fig. 13.—*Diagram illustrating Fig.* 12.

Thus the combination of tuned circuit and rectifier may be represented, as far as the fundamental frequency is concerned, by a single resistance R_3, where $R_3 = \frac{1}{1/R'_1 + 2/R_2}$. See Fig. 12.

Hence the total current i_T at the fundamental frequency entering the combination —when $e_b = 0$—may be represented by a new load line BO of slope $\frac{1}{R_3}$ drawn on the diode characteristics.

Now i_T also flows in R_a and the total P.D. round the circuit must equal $\mu \hat{e}_g = \hat{E}$, where $e_g = \hat{e}_g \sin \omega t$ is the input to the valve grid. This is illustrated graphically in Fig. 13.

Application of Bias to the Rectifier

If bias is applied to the rectifier the load line OB will be displaced to the left or right of the position it occupies in Fig. 13, according as it is negative or positive.

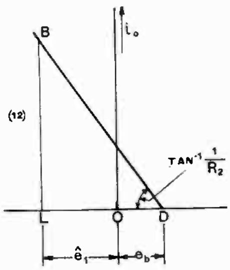


Fig. 14.

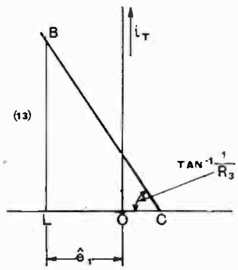


Fig. 15.

Application of positive bias. Diagrams for rectifier alone and with tuned circuit.

Fig. 14 represents the D.C. load line for the rectifier, from which, for the case of positive bias,

$$i_0 = \frac{(\hat{e}_1 + e_b)}{R_2},$$

$$\text{Hence,}\quad \hat{\imath}_T = \frac{\hat{e}_1}{R'_1} + \frac{2(\hat{e}_1 + e_b)}{R_2}$$

$$= \frac{\hat{e}_1}{R_3} + \frac{e_b}{R_2/2}$$

Fig. 15 shows the load line for the combination of R'_1 and the rectifier—from which :—

$$\hat{\imath}_T = \frac{(\hat{e}_1 + OC)}{R_3} = \frac{\hat{e}_1}{R_3} + \frac{e_b}{R_2/2}$$

$$\text{Hence,}\quad OC = e_b \times \frac{R_3}{R_2/2}.$$

Similarly, for the case of negative bias, the

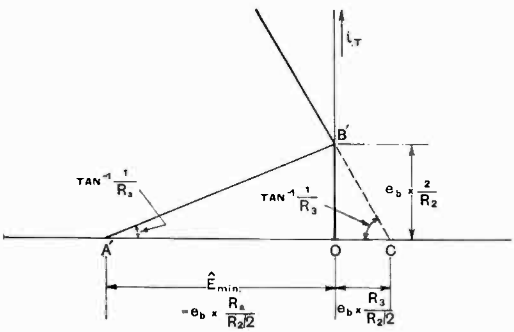


Fig. 16.—*Application of positive bias.*

length $OC = e_b \times \frac{R_3}{R_2/2}$, but C is on the other side of O.

It should be noted here that the load line of slope $\frac{1}{R_3}$ is only valid as long as both R'_1 and the rectifier carry current at the fundamental frequency. Now, with positive bias, the current in R'_1, becomes zero when $v_0 = R_2 i_0 \leqslant e_b$, for then D.C. flows continuously in the diode and the rectifier path has zero impedance and hence $\hat{e}_1 = 0$. With negative bias, D.C. ceases to flow in the diode when $\hat{e}_1 \leqslant e_b$, when fundamental current flows only in R'_1. These limitations are represented in Figs. 16 and 17 as discontinuities in the load line.

From these diagrams two important conclusions may be drawn :—

(1) *With positive Bias* :—for a carrier input voltage to the valve equal to or less than

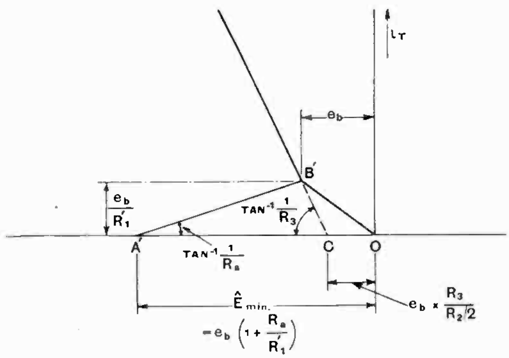


Fig. 17.—*Application of negative bias.*

$\frac{1}{\mu}\left(e_b \times \frac{R_a}{R_2/2}\right)$ no voltage at the input frequency is set up across the combination of R'_1 and the rectifier.

(2) *With negative Bias* :—for a carrier input voltage to the valve equal to or less than $\frac{1}{\mu}\left(1 + \frac{R_a}{R'_1}\right)e_b$ no D.C. flows in the diode and hence there is no output.

Modulated Input :—$\omega \gg n$

If now the input voltage to the valve is modulated and of form $\hat{E}$ $(1 + m \sin nt)$ $\sin \omega t$, the resulting voltage set up across R'_1 and rectifier can be traced out on Fig. 13. Thus :—OA = valve input carrier voltage $\hat{E}$, and over the modulation cycle the line AB will move parallel to itself to left and right of the operating point A between the limits $\pm m\hat{E}$. It is clear that with zero bias the modulation envelope of $\hat{E}$ will be followed exactly by i_T even up to 100 per cent. modulation, and, since there are no discontinuities in the line OB, the rectifier output will also be undistorted.

If bias is present the maximum acceptable modulation depth is limited by the discontinuities shown in Figs. 16 and 17.

It should also be clearly seen that, with m sufficiently small to avoid distortion, the modulation depth of the diode input voltage will be greater or less than m as the bias is positive or negative.

Modulated Input—Indirect Coupling : $\omega \gg n$

For indirect coupling a new load line must be drawn, which will clearly have a slope equal to $\frac{1}{R_4} = \left(\frac{1}{R'_1} + \frac{1}{R_e/2}\right)$, where R_e is effective impedance of the diode load at the modulation frequency.

Fig. 18 shows the new diagram. A discontinuity will occur in the new load line BC, since the diode ceases to conduct when the mod. depth equals or exceeds $\frac{R_e}{R_2}$, but is not shown.

Assuming the mod. depth is low enough to avoid distortion certain interesting relations can be derived from this diagram.

Valve input E.M.F. mod. depth

$$= m = \frac{AD}{AO} = \frac{BE}{BO} = \frac{LN}{LO}$$

Diode input voltage mod. depth

$$= m_d = \frac{LM}{LO} = \frac{BG/R_4}{LO} = m \cdot \frac{BG/R_4}{LN}$$

Now, $MN = HI = EI \cdot R_a = BG \cdot \frac{KI}{GK} \cdot R_a,$

$$= BG \cdot \frac{KH}{KF} \cdot R_a,$$

$$= BG \cdot R_a \cdot \left[\frac{R_3 - R_4}{R_3 + R_a}\right]$$

$$\therefore LN = GI = GH + HI$$

$$= BG \cdot R_4 + HI,$$

$$= BG \cdot R_4\left[1 + \frac{R_a}{R_4} \cdot \frac{(R_3 - R_4)}{(R_3 + R_a)}\right],$$

$$= BG \cdot R_3\left[\frac{R_4 + R_a}{R_3 + R_a}\right]$$

$$\therefore \quad m_d = m \cdot \frac{(1/R_3 + 1/R_a)}{(1/R_4 + 1/R_a)}.$$

Hence m_d is less than m since $R_3 > R_4$. This is similar to the case for negative bias.

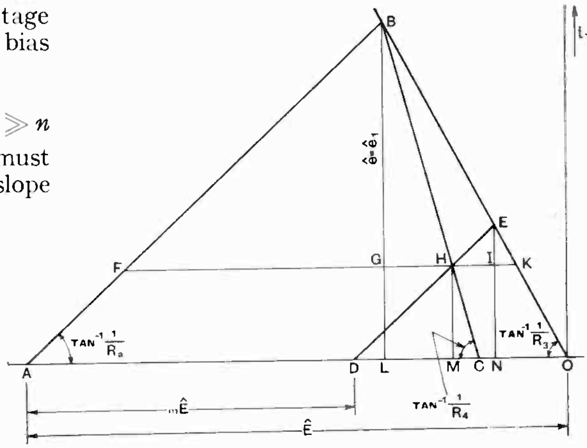


Fig. 18.—*Diagram for modulated input, indirect coupling, and zero bias.*

Also, $FH = m\hat{E} = BG(R_4 + R_a)$,

$$\therefore \ BG = \frac{m\hat{E}}{(R_4 + R_a)},$$

$$\text{similarly, } BL = \frac{\hat{E}}{(R_3 + R_a)},$$

$$\therefore \text{ mod. depth of } i_T = m_{i_T} = m \cdot \frac{(R_3 + R_a)}{(R_4 + R_a)}.$$

$$\therefore \quad m_d = m_{i_T} \cdot \frac{R_4}{R_3}.$$

The application of positive bias will cause the lines BO and BC to occupy positions $B'O'$ and $B'C'$ parallel and to the right of those shown in Fig. 18. For one value of bias the point C' will coincide with the origin O, when both the input to and output from the rectifier will be undistorted, since it is easily shown that both the modulation load lines for i_0 and i_T pass through their respective origins for this value of bias. For *any other value of carrier* distortion will occur above a certain depth of modulation and for small carriers will be very much worse than with no bias.

Effect of Reactance across R'_1 or R_2

Hitherto we have assumed R'_1 and R_2 to be pure resistances over the range of side-band frequencies, now we will consider the effect of reactances across them.

The tuned circuit has been represented in Fig. 11 as a resistance R' shunted by a loss-free parallel tuned circuit L_1C_1.

$\therefore$ Admittance across R'_1

$$= \left(\omega C_1 - \frac{1}{\omega L_1}\right) \approx \pm\, 2nC_1,$$

— if $\omega = \omega_r \pm n$, $\omega_r^2 = \dfrac{1}{L_1C_1}$, and n = mod. frequency.

$\therefore i_c$ = current into $R'_1L_1C_1$ for an input $e_1 = \hat{e}' \sin \omega_r t$,

$$= \hat{e}_1\left(\frac{1}{R'_1} \pm j\,.\,2nC_1\right) \sin \omega_r t.$$

Now suppose e_1 to be modulated so that $e_1 = \hat{e}_1(1 + m_d \sin nt) \sin \omega_r t$,

or, $e_1 = \hat{e}_1 (\sin \omega_r t + m_d \sin nt \sin \omega_r t)$

$$\therefore i_c = \hat{e}_1\left[\frac{1}{R'_1} + m_d\left(\frac{1}{R'_1} \pm j\,.\,2nC_1\right)\sin nt\right]\sin \omega_r t.$$

Hence, if we take the carrier operating point—B in the above diagrams—as origin and consider the envelope of this expression alone,

$$i_{cm} = m_d\hat{e}_1\left(\frac{1}{R'_1} \pm j\,.\,2nC_1\right) \sin nt$$

$$= \hat{e}_{1m}\left(\frac{1}{R'_1} \pm j\,.\,2nC_1\right) \sin nt.$$

—which, as shown in Part I, represents an ellipse when plotted on co-ordinate axes.

Now, as also shown in Part I, the variable component of

$$i_0 \text{ — i.e. } i_{0m} = \hat{e}_{1m}\left(\frac{1}{R_e} + jnC_2\right) \sin nt,$$

which also represents an ellipse. Hence the variable component of the rectifier current at the fundamental frequency $= 2i_{0m} = i_{1m}$

$$\therefore i_{1m} = 2\hat{e}_{1m}\left(\frac{1}{R_e} + jnC_2\right) \sin nt.$$

The sign before $j2nC_1$ merely defines the direction in which the ellipse is traced, and the two ellipses for i_{cm} and i_{1m} may be combined if they are both traced in the same direction :—

Thus, $i_{Tm} = i_{1m} + i_{cm}$

$$= \hat{e}_{1m}\left[\frac{1}{R_4} + j\,.\,2n(C_1 + C_2)\right] \sin nt,$$

$$= \left[\frac{e_{1m}}{R_4} \pm 2n(C_1 + C_2)\,(e_1{}^2{}_m - e_1{}^2{}_m)^{\frac{1}{2}}\right]$$

—which describes the method of superimposing the ellipse on the load line BC. See Figs. 9 and 19.

From Fig. 19 it is easily shown that

$$\frac{LP}{LM} = \frac{1}{(1 + n^2T^2)^{\frac{1}{2}}}$$

— where $T = 2R_4(C_1 + C_2)$.

The line PQ is tangential to the ellipse

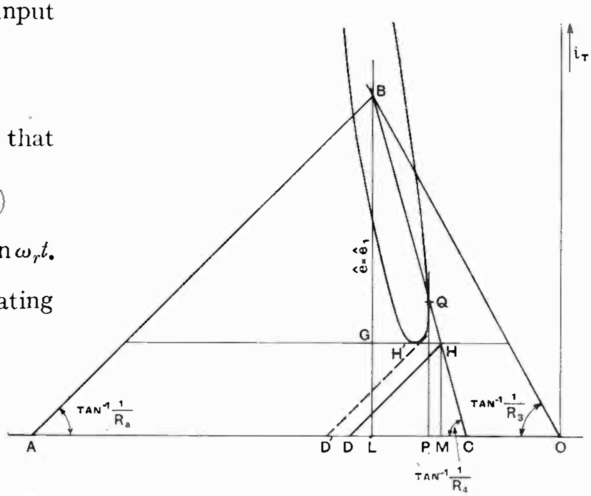


Fig. 19.—*As Fig. 18, but considering reactance across R_1 and R_2.*

and m_d now equals $\dfrac{LP}{LO}$. Strictly, at the max. excursion of the point D, the line DH should be tangential to the ellipse, but we may assume with sufficient accuracy—if $R_a \gg R_4$—that AD is negligibly different from AD', where $D'H'$ is the tangent.

Now it has been shown that,

$$\frac{LM/LO}{AD/DO} = \frac{(1/R_3 + 1/R_a)}{(1/R_4 + 1/R_a)}$$

Now $\dfrac{AD}{DO} = m$, and $\therefore m_d = \dfrac{LP}{LO} = \dfrac{LM}{LO} \times \dfrac{LP}{LM}$

$$= m \cdot \frac{(1/R_3 + 1/R_a)}{(1/R_4 + 1/R_3)} \cdot \frac{1}{(1 + n^2T^2)^{\frac{1}{2}}}.$$

In terms of

$$m_{iT}\left(=\frac{BG}{BL}\right),\ m_d = m_{iT} \times \frac{R_4/R_3}{(1 + n^2T^2)^{\frac{1}{2}}},$$

without approximation.

Fig. 20 shows a diagram, similar to Fig. 19, but for the case of application of negative bias. The form of e_1, for a modulated input current $i_T = \hat{i}_T (1 + m_{iT} \sin nt) \sin \omega_r t$, can be written down almost by inspection, in terms of $\hat{i}_T$ and $m\hat{i}_T$, to give an expression similar to one derived by Williams.

Thus, $e_1 = [OL + LP \sin (nt - \theta)] \sin \omega_r t$, where $\theta = \tan^{-1} 2nR_4(C_1 + C_2)$ = effective phase angle to mod. frequency.

$$\text{Now,}\quad LP = LR \cdot m_{iT} \cdot \frac{R_4/R_3}{(1 + n^2T^2)^{\frac{1}{2}}}$$

$$= m_{iT} \cdot \frac{R_4\hat{i}_T}{(1 + n^2T^2)^{\frac{1}{2}}}.$$

$$\text{Also}\quad OL = R_3\left(\hat{i}_T + \frac{e_b}{R_2/2}\right)$$

$$\therefore e_1 = \left[R_3\left(\hat{i}_T + \frac{e_b}{R_2/2}\right) + m_{iT} \cdot \frac{R_4\hat{i}_T}{(1 + n^2T^2)^{\frac{1}{2}}} \cdot \sin (nt - \theta)\right] \sin \omega_r t.$$

If e_b is positive, the first term becomes $R_3\left(\hat{i}_T - \frac{e_b}{R_2/2}\right)$. The discontinuity in the load line BC, for negative bias e_b, occurs when the mod. depth of e_1 equals

$$\frac{R_e}{R_2} \times \frac{(1 - e_b/\hat{e}_1)}{(1 + n^2C_2^2R_2^2)^{\frac{1}{2}}},$$

but again is not shown.

Limitations of the Above.

If the diode characteristics, shown in Fig. 4, are not equidistant parallel straight lines, the load line for i_0—when reactance is considered—cannot be represented by an ellipse, hence neither can the load line for i_T.

In general, neglecting reactance, the effective input resistance at the carrier and sideband frequencies will be of the form $\frac{R_2}{2K_1}$ and $\frac{R_e}{2K_2}$ respectively, but $K_1 \pm K_2$ even if the lines are equidistant unless they are vertical.

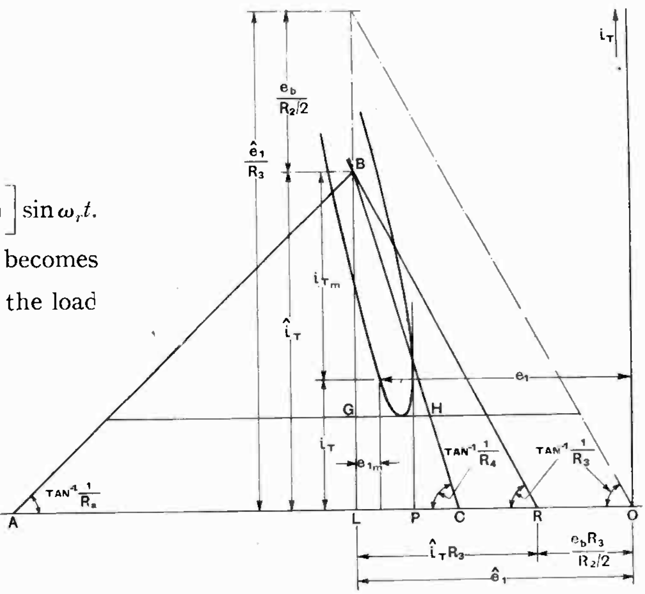


Fig. 20.—*As Fig. 19, but with negative bias on diode.*

Conclusions

It will be seen that although the connection of the rectifier across the tuned circuit reduces the carrier voltage set up across the tuned circuit—in the ratio $\frac{(1 + R_a/R'_1)}{(1 + R_a/R_3)}$—and consequently "flattens" the tuning curve, the response curve will or will not be "flatter" than that of the tuned circuit alone according as the bias is positive or negative.

The conditions for distortionless rectification for all values of carrier are zero bias and direct coupling. With indirect coupling, the application of positive bias will cause the rectification to be distortionless for one value of carrier only. With negative bias, distortion will always be present above a certain depth of modulation.

Either positive or negative bias may be used for "muting" at low carrier levels.

It may be observed that, however the distortion is caused, it only occurs on the "inward" peaks of modulation, consequently only half the modulation cycle has been shown in each diagram. The nature of the distortion may be studied by means of these diagrams.

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Correspondence

Letters of technical interest are always welcome. In publishing such communications the Editors do not necessarily endorse any technical or general statements which they may contain

Theory and Applications of Electron Tubes

To the Editor, The Wireless Engineer.

SIR,—In his review of my book, "Theory and Applications of Electron Tubes," on page 286 of the June issue of *The Wireless Engineer*, G. W. W. makes a number of criticisms of the first three chapters. In order to enable me more readily to remedy weaknesses when the time comes for revision, I would be very grateful if G. W. W. would give me more detailed comments on a number of points. I realise that this is an unfortunate time to make such a request, but hope that your reviewer is in a position to help me. My specific questions follow.

1. In what manner does the discussion of the action of the control grid on pages 39 and 40 give a false picture of the mechanism of the control of space current? Would it be possible to give a more rigorous presentation that could be readily understood by undergraduate students who have not had an advanced course in electrodynamics? Would the more complicated rigorous treatment actually be desirable in view of the purpose for which the book was intended, as set forth in the second paragraph of the preface?

2. I believe that in every case the additional grids contained in hexodes and heptodes serve as control grids, accelerating grids, shield grids, or anodes and that the action of these grids does not differ from those serving similar functions in triodes, tetrodes, and pentodes. I believe that this accounts for the fact that "no adequate analysis of their operation and characteristics has been given in any text book." I feel that the real weakness of the book in this respect lies not in the failure to include a complete rigorous physical analysis of the operation of tubes with more than three grids, but rather in the absence of a specific discussion of the use of such tubes as converters and mixers. Although the principles involved in these applications are adequately presented, it is my intention to add sections on this subject when the book is revised. Just what sort of analysis of the operation and characteristics of hexodes and heptodes should be included? I would appreciate having references to articles covering the subject in a suitable manner.

3. How much material should be added on the subject of secondary emission? The phenomenon of secondary emission is a complicated one on which one might readily write a small book. Thomson and Thomson in "Conduction of Electricity Through Gases," devote 40 pages to this subject, and much has been written since the publication of this book in 1928. I believe that my treatment is as complete as that contained in other books on the characteristics and applications of electron tubes and that it is adequate to an understanding of the secondary emission phenomena discussed in later chapters of the book. Further comments on this point would be helpful.

4. I have made every effort to make my bibliographies as complete as possible, and to this end have made frequent use of the various abstract journals, including *The Wireless Engineer*. It is difficult, however, not to miss occasional references of importance. I shall be grateful for a list of subjects on which "so many important papers published outside America have not been mentioned," or, better still, a list of these papers, if that would not require too much time. A check reveals that of the 1,090 references given in the book, 770 are to papers published in the United States, 222 to papers published in England, and 98 to papers published in other foreign countries. In the ten chapters preceding thyratrons, ignitrons, and other gaseous tubes, which were developed largely in the laboratories of the General Electric and Westinghouse companies in this country, there is approximately one English reference for each two American references. In view of the fact that the book was written primarily for use in American colleges and that relatively few of those readers for whom the book was intended will have occasion to look up the original papers, it seems to me that emphasis on American papers is not unduly heavy. A review in the *Television and Short-wave World* contains the statement: "It is pleasant to note that due prominence is given to British writers." One of the reviewers who reviewed my manuscript before publication said that there were too many foreign references and that many important American references had been overlooked. I found that he had failed to note the many references given throughout the chapters as foot-notes. I am wondering whether a similar oversight may have been made by G. W. W.

HERBERT J. REICH,
Professor of Electrical Engineering.
University of Illinois.

Triode Oscillators for Ultra-Short Wavelengths

To the Editor, The Wireless Engineer.

SIR,—I have read with great interest Mr. Ratsey's letter in the September issue of *The Wireless Engineer* on the possible effects of the relative phase relationships of the electrode currents and voltages on the performance of oscillators at ultra-short wavelengths.

Mr. Ratsey uses Moullin's results for the electron transit time in a cylindrical diode to show that the experimental results quoted in the original article would indicate that the short wave limit is reached when the transit time lies between one quarter and one half of a period. However, the valves used in the experiments were of such dimensions that the transit times as determined by Moullin differ by less than 10 per cent. from the transit times for the corresponding planar diodes. Thus even in the most unfavourable case, the experimental results would indicate that the limiting wavelength is reached when the transit time is within 10 per cent. of one half period.

I agree with Mr. Ratsey that advance of the phase of the grid voltage due to grid current loading may be the explanation of the discrepancy between the theoretical and experimental determinations of the onset of transit time effects. However, the nature of the generalisations made in the theory in this case was such that there is bound to be considerable deviation from practical results and the idealised theoretical determinations, and it is extremely difficult to decide which of the generalisations is responsible for the deviation in any particular case.

I would add that special consideration to relative phases was not given on account of their indeterminacy, and the work was done in an attempt to obtain simple design data applicable to any valve.

In conclusion, it may be of interest to add that since the writing of the article in question, two valves, of a construction differing widely from those described in the article, have been investigated and both show remarkably good agreement with the formulae for the wavelength limit and the onset of transit time.

Wembley.

M. R. GAVIN,
Research Staff of the
M.O. Valve Co. Ltd.

A.V.C. Characteristics and Distortion

To the Editor, The Wireless Engineer.

SIR,—I read with great interest the article on A.V.C. Characteristics and Distortion by Drs. E. G. James and A. J. Biggs, which was published in the September, 1939, issue of *The Wireless Engineer.*

May I take the liberty of calling your attention to a graphical method which I devised for the determination of A.V.C. characteristics and which I communicated to the Editor of *L'Onde Electrique ?* The latter was kind enough to have this communication published in the form of an article which appeared in the August, 1935, issue of *L'Onde Electrique.*

PAUL MANDEL.

Paris.

Complex Variable and Operational Calculus

By N. W. McLachlan, D.Sc. (Eng.). Pp. 355 + xii and 72 Figs. Published by the Cambridge University Press, Bentley House, 200, Euston Road, London, N.W.1. Price 25s.

In writing this book it has been the author's aim to elucidate the principles underlying functions of a complex variable, and their application to operational calculus, by a clear and connected exposition of the fundamental theory. He has succeeded in his purpose. The language is that of the technologist rather than that of the pure mathematician, and the author has courageously determined that clarity of presentation shall prevail over a rigorous, and perhaps tedious, justification of every step. Proofs of theorems are omitted when no advantage is to be gained by their inclusion—the author's outlook is defined by the statement in his preface. "Just as the mathematician does not need to be versed in thermodynamics and internal combustion engine design to drive a motor car, the technologist need not know how to prove all the theorems he uses. But like the mathematical motorist, he must be acquainted with the highway code." Every effort is made in the book to assist the reader and to maintain his interest ; use is made of simile to illustrate points of difficulty, and the use of examples to reinforce precept is characteristic of the author.

Part I of the book deals with the theory of the complex variable ; in Chapters I–III the concept of functions of a complex variable is developed, the properties of poles and branch points are described, and the reader is introduced to the meaning of integration along a contour in the complex plane. Cauchy's theorem is stated, and from a consideration of Taylor's and Laurent's theorem, the calculus of residues is approached. Chapter IV is devoted to the contour integral of Bromwich and Wagner, and stress is laid on the application of this integral to physical problems. Chapter V deals with the contour integral representation of the Gamma functions of Euler, the error function, and Bessel functions. In Chapter VI the solution of the Bromwich integral, when the integrand has branch points, is studied. Chapter VII introduces the meaning of the differentiation and integration of a contour integral under the integral sign.

Part II is devoted to symbolic or operational calculus (the latter nomenclature being Heaviside's). The development of this very powerful weapon in the armamentarium of the mathematical physicist is based upon the Bromwich-Wagner contour integral and Laplace's infinite integral. The interpretation of a function of time in terms of the Bromwich-Wagner integral, and the converse process of expressing a function of "p" by means of Laplace's integral, are equivalent, the link between them being the Mellin inversion theorem. The author bases the theory of operational calculus upon the Mellin theorem, a rigorous proof of which is included in an appendix. Heaviside's heuristic method of attack is discarded on account of its experimental nature, and "p" is considered not as an operator identically equal to d/dt, but as an "inversion parameter" in the relation between f(t) and ϕ (p) expressed by the Mellin transform. It is, perhaps, a matter of regret from the historical point of view that Heaviside's expansion theorems are not mentioned by name ; their enunciation and the establishment of the proof of their validity by the author's method would have been of interest.

Three chapters are included in Part II. Chapter VIII deals with operational theory based on the Mellin inversion theorem, and a number of operational forms are derived. The author employs a new symbol to indicate the symbolic or operational relation of $f(t)$ with $\phi(p)$, writing $f(t)\phi(p)$, thus avoiding the confusion caused by the sign of equality used by Heaviside, and the $\doteq$ sign adopted by van der Pol and others. The "shift function" is described, and among other examples are included derivations of Fourier expansions by operational methods. Chapter IX is concerned with the operational solution of linear differential equations. In Chapter X, Heaviside's unit function is studied in terms of an integral along the Bromwich contour, and the operational forms of a number of discontinuous functions of time are given. The chapter concludes with a brief section on impulses.

Part III is devoted to the technical applications of the foregoing theory in Parts I and II, and the author is to be congratulated on the remarkably wide selection of material which he has provided. Among the examples given are the solutions of problems in connection with electrical networks, aeroplane dynamics and general physics. The communications engineer will find much of interest in this part of the book, and the worker in acoustics and the industrial physicist are not forgotten. In essence, the solution of the problems in this part of the book is obtained by the transformation of the original differential equation into its operational form, after which the solution is obtained by evaluation of the corresponding Bromwich-Wagner contour integral. The reader who desires to attain proficiency in the solution of similar problems is afforded ample opportunity by the author, who has included at the end of Chapter XV eighty-one examples covering every aspect of the subject.

The concluding part of the book, Part IV, is composed of appendices and references. The inclusion of a number of theorems and formal proofs in an appendix rather than in the main body of the work avoids over-burdening the reader with material with which he need not immediately concern himself, while providing him with useful references. Among the eleven sections in this part of the book may be found a discussion of asymptotic series, a rigorous proof of the Mellin inversion theorem, and a dissertation on transformation of contour. A non-rigorous proof of the "produit de composition" or Borel's theorem is given, and certain applications of it are shown. Finally, a number of proofs of operational formulae are given and an all too short list of thirty-eight operational forms is included. An excellent bibliography is appended, marked to indicate references in which lists of operational forms may be found.

In conclusion, it may be said that this latter work of Dr. McLachlan is a worthy companion to his two previous works in the field of industrial mathematics. The technologist and engineer concerned with mathematical analysis should find the information in this book, and its method of presentation, of real service to him. W. P. W.

Spontaneous Fluctuations of Voltage Due to Brownian Motions of Electricity, Shot-Effect and Kindred Phenomena.

By E. B. Moullin. Pp. VIII + 251, 88 Figs. Oxford University Press, Amen House, Warwick Square, London, E.C.4. Price 17s. 6d.

This is one of the volumes in the Oxford Engineering Science Series, of which the author is one of the general editors. Mr. Moullin and his associates, notably F. C. Williams and D. A. Bell, have done much experimental work of a pioneer character in this difficult subject in the Engineering Laboratory at Oxford University, and the book is written largely from first-hand experience. Knowing this, one is the more favourably impressed by the modesty of the preface. The author confesses that there is much in the physical phenomena of fluctuation not yet understood, that he has had to weave the story as he went along, trying to fit the pieces of the puzzle together, continually rewriting and rearranging, and that, although much is known, the keystone is still missing. "Could I have found it," he says, "the book would have been arranged very differently." The author asks that the book be read with an eye for detecting clues that he may have missed.

The microscopic agitation of particles in a liquid or gas has long been known under the name of Brownian movement, but although the electrical analogy was mooted some years previously it was not until 1928 that J. B. Johnson observed a fluctuation voltage between the ends of a conductor. This voltage is very minute and requires highly refined technique for its accurate measurement. The other effect, the so-called shot-effect, is perhaps more obvious since one has always pictured the current in a valve as a stream of discreet charges raining upon the anode, and one might expect to hear the pitter-patter if he listened carefully with a sufficiently sensitive electrical ear. Unfortunately one cannot avoid hearing it in a very sensitive amplifier, and the background noise so produced sets a limit to the useful amplification.

Mr. Moullin covers the whole field very carefully, starting from the kinetic theory of gases, and developing the arguments step by step, comparing theory with the results of experiments and discussing the difficulties and discrepancies at every step.

It is not an easy book to read, but that is the fault of the subject and not of the author—except when, as in equation 2 on page 4, he uses a symbol Δx^2 which he has not defined, and leaves one in some doubt as to the implications of the equation. The first chapter deals with thermal fluctuation voltages in conductors, the second with the shot-effect, the third with the physics of the diode, the fourth with space-charge limited diodes and with a number of experimental results which are compared with the theory developed in the previous chapter. The fifth is a short chapter dealing with fluctuations in multi-electrode *tubes*—do they talk American at Oxford? Chapter VI deals with flicker effect, ionisation effect and secondary emission, all being phenomena intimately associated with the shot-effect. The final chapter deals with a number of important technical problems involving fluctuations and also with the technique of their measurement. An appendix contains "stop-press" matters that came to light too late for incorporation in the main body of the book.

Numerous references are given throughout to the literature of the subject, the discussions and criticisms of which show that the author has left no stone unturned in his efforts to get to the bottom of the subject and discover the missing keystone. There is throughout a critical appreciation of the work of other scientists and an admirable open-mindedness to the conflicting results and theories that have been propounded.

This is a book which is absolutely indispensable to anyone who takes a serious interest in this subject. G. W. O. H.

Abstracts and References

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For the information of new readers it is pointed out that the length of an abstract is generally no indication of the importance of the work concerned. An important paper in English, in a journal likely to be readily accessible, may be dealt with by a square-bracketed addition to the title, while a paper of similar importance in German or Russian may be given a long abstract. In addition to these factors of difficulty of language and accessibility, the nature of the work has, of course, a great influence on the useful length of its abstract.

PROPAGATION OF WAVES

4275. CURVED WAVE-GUIDES [Study more Important than That of Deformed-Section Guides: Analysis shows that E-Wave cannot be Propagated, that H-Wave can, under Certain Conditions].—S. Sonada, S. Morimoto, & M. Ito. (*Electrot. Journ.*, Tokyo, Sept. 1939, Vol. 3, No. 9, pp. 215–216.) "Brillouin [3096 of 1938] has treated the problem somewhat qualitatively, but no one has dealt with it analytically so far as the present authors are aware."

4276. ON THE QUESTION OF THE USE OF WAVES IN TUBES AS TRANSMISSION CHANNELS [Straightforward Exposition for Engineers, including the Problem of the Practical Design of Long Wave-Guides and the Difficulties in avoiding Prohibitive Attenuation over Long Distances: Real Application lies in Use for Resonance Circuits, High-Pass Filters, Horn-Shaped Radiators, & Medium-Length Feeders].—O. Schriever. (*Telefunken-Hausmitteilungen*, July 1939, Vol. 20, No. 81, pp. 55–64.)

4277. EXPERIMENTAL RESEARCHES ON THE PROPAGATION OF ELECTROMAGNETIC WAVES IN DIELECTRIC (CYLINDRICAL) GUIDES.—Clavier & Altovsky. (*Elec. Communication*, July 1939, Vol. 18, No. 1, pp. 81–105.) "Republished in slightly modified form" from the French paper (3421 of September).

4278. PROGRESS ON 225 MEGACYCLES AT MOUNT WASHINGTON [Behaviour of 1 m Signals over Long Paths, up to 92 Miles: Types of Fading].—A. E. Bent. (*QST*, Sept. 1939, Vol. 23, No. 9, pp. 62–64.)

4279. POSSIBLE EFFECT OF THE EARTH'S ELECTRIC FIELD ON INTENSITIES IN THE ABSORPTION SPECTRUM OF THE EARTH'S LOWER ATMOSPHERE [Colaba Observatory Observations: Correlation between Earth's Potential Gradient and Atmospheric Opacity].—A. B. Arlick. (*Sci. & Culture*, Calcutta, July 1939, Vol. 5, No. 1, pp. 62–63.)

Results indicate that "the correlation is not uniform but such as to suggest that the field has a selective effect on the spectral composition of molecules of the intervening lower air when viewed with the feeble light of the night sky as background . . . Since the selective action of the earth's electric field is of significance in atmospheric conductivity, in the formation of condensation nuclei, the estimating of visibility, atmospheric refraction in the visible, and the attenuation of ultra-short radio waves, the importance of obtaining a confirmation or otherwise of these 'effects' from other workers cannot be too strongly urged."

4280. PROPAGATION OF ULTRA-SHORT WAVES: RESULTS OF ECKERSLEY'S THEORY [Detailed Discussion of the Eckersley Curves (for Transmitter Heights between 0 and 4000 m) with Addition of Dots representing Optical Ranges].—F. Bedeau & J. de Mare. (*L'Onde Élec.*, July 1939, Vol. 18, No. 211, pp. 289–304.) For Eckersley's paper *see* 1660 of 1937.

4281. NOTES ON THE RANDOM FADING OF 50-MEGACYCLE SIGNALS OVER NON-OPTICAL PATHS.—K. G. Maclean & G. S. Wickizer. (*Proc. Inst. Rad. Eng.*, Aug. 1939, Vol. 27, No. 8, pp. 501–506.) A summary was dealt with in 3425 of September.

4282. Weather and Wireless [Ultra-Short-Wave Observations].—J. A. Ratcliffe & A. H. Waynick: Heightman. (*Wireless World*, 17th Aug. 1939, Vol. 45, pp. 160–161.)
Prompted by Heightman's article (3876 of October).

4283. Ultra-Short-Wave Ranges in the Summers of 1938 and 1937 [Short Comparison of Some European & American Results: the Occasionally Local Nature of the Favourable Conditions].—E. Fendler. (*Funktech. Monatshefte*, June 1939, No. 6, pp. 190–191.)

4284. Scattered Propagation of Short Waves around 30 Mc/s [Observations on Fundamental & Second Harmonic of 13.98 Mc/s Wave (Hsinking) over 1500 km: Occurrence of "Quasi-Regular" Reflection for the Second Harmonic].—K. Ohno, M. Nakagami, & K. Miya. (*Electrot. Journ.*, Tokyo, July 1939, Vol. 3, No. 7, p. 168.)

4285. Correction to Curves in "Ground and Ionospheric Rays."—W. Ross. (*Wireless Engineer*, July 1939, Vol. 16, No. 190, pp. 349–350.) *See* 2986 of 1937.

4286. Propagation Characteristics of High-Frequency [*e.g.* 10–20 Mc/s] Radio Waves over Short Distances [of New Importance for Mobile Services, Aviation, etc: with Field-Intensity Curves for Distances 200–3000 km].—K. Maeda, H. Yokoyama, & T. Tukada. (*Nippon Elec. Comm. Eng.*, July 1939, No. 17, pp. 40–48.)

4287. Low-Power Transmission: Long Ranges on One Watt [up to 500 Miles on 7 Mc/s Band].—W. Oliver. (*Wireless World*, 14th Sept. 1939, Vol. 45, pp. 251–253.)

4288. Temperature of the Stratosphere in High Latitudes [is Very High in Summer and Very Low in Winter: Deductions from Computations of Mean Temperature of Atmospheric Ozone, agreeing with Radio-Sounding Measurements].—A. & E. Vassy. (*Nature*, 12th Aug. 1939, Vol. 144, p. 284.) *See* 3057 (and 3058) of August.

4289. Temperature Parameters from Negative Bands of Nitrogen under Excitation by Electron Impact.—O. S. Duffendack & K. T. Chao. (*Phys. Review*, 15th July 1939, Series 2, Vol. 56, No. 2, pp. 176–184.)

4290. On the Production of the Ionospheric Regions E and F and the Lower-Altitude Ionisation causing Radio Fade-Outs [Nitrogen & Oxygen Absorptions (F & E Regions respectively): Fade-Out Ionisation probably due to Near-Ultra-Violet Absorption by Ozone: Suggested Laboratory Experiment].—O. R. Wulf & L. S. Deming. (*U.R.S.I. Proc. of* 1938 *Gen. Assembly*, Fasc. 1, Vol. 5, 1938, p. 380: summary only.)

4291. The Measurement of the Earth's Magnetic Field at High Altitudes deduced from the Study of the Ionosphere.—R. Jouaust, É. Thellier, & H. Jardy. (*Comptes Rendus*, 16th Aug. 1939, Vol. 209, No. 7, pp. 382–384.)
Results similar to those obtained by Appleton (1934 Abstracts, p. 373); deductions from simultaneous reflections from E and F regions.

4292. The Structure of the Atmosphere as deduced from Ionospheric Observations [Nature of Ionospheric Evidence: Estimates of Atmospheric Scale-Height H from Ionised Layer Structures: Estimates of Air Densities from Measurements of Electron Collision Frequencies].—E. V. Appleton. (*Quart. Journ. Roy. Met. Soc.*, July 1939, Vol. 65, No. 281, pp. 324–328.)

4293. Opening Address by the President of the U.R.S.I.—E. V. Appleton. (*U.R.S.I. Proc. of* 1938 *Gen. Assembly*, Fasc. 2, Vol. 5, 1938, pp. 4–8: in English.)

4294. Report on the Relation between the Registered Theory of Transmission [especially the Writer's Eigen-Value Solutions and the Relations between Ray and Wave Theories].—T. L. Eckersley. (*U.R.S.I. Proc. of* 1938 *Gen. Assembly*, Fasc. 2, Vol. 5, 1938, pp. 47–49: in English.)

4295. Report on the Limits between which the Approximate Methods of Geometrical Optics are Valid in Wave Optics, with Application to Radioelectric Waves.—C. Manneback. (*U.R.S.I. Proc. of* 1938 *Gen. Assembly*, Fasc. 1, Vol. 5, 1938, pp. 372–374: summary only, in French.) *Cf.* Graffi, 2652 of July.

4296. On the Propagation of Light in Inhomogeneous Media [System of Simultaneous Differential Equations giving Connection between Incident and Reflected Wave in Medium Inhomogeneous in One Direction only: Solutions for Very Thin Layers with Arbitrary Variation, and for Thick Layers with Slowly Variable Refractive Index: Results].—P. H. van Cittert. (*Physica*, Aug. 1939, Vol. 6, No. 8, pp. 840–848: in English.)

4297. An Approximate Solution of the Wave Propagation Formula in the Ionosphere [using Cylindrical Functions of the Third Kind].—T. Tukada. (*Nippon Elec. Comm. Eng.*, May 1939, No. 16, pp. 628–629: long summary only.)

4298. Hamilton's Canonical Equations for the Motion of Wave Groups.—Fokker. (*See* 4754.)

4299. Report of Commission II: Radio Wave Propagation.—J. H. Dellinger. (*U.R.S.I. Proc. of* 1938 *Gen. Assembly*, Fasc. 1, Vol. 5, 1938, pp. 289–294.)

4300. IONOSPHERE DURING MORNING TWILIGHT [Actual Pre-Dawn Increase of E-Layer Ionisation considerably Greater than Calculated Value from Simple Photoelectric Theory for Quiet Atmosphere: Explanation by Ionising-Ray Scattering more Plausible than by Winds or Atmospheric Refraction].—E. O. Hulburt. (*U.R.S.I. Proc. of* 1938 *Gen. Assembly*, Fasc. 1, Vol. 5, 1938, p. 384: summary only.)

4301. THE REFRACTION OF PLANE ELECTROMAGNETIC WAVES AT A PLANE SURFACE OF SEPARATION BETWEEN AIR AND EARTH.—R. M. Wundt & O. Cordsmeier. (*Lorenz Berichte*, June 1939, No. 1/2, pp. 52–63.)

The general theory of the reflection and refraction of plane electromagnetic waves at a plane surface of separation has been known for a long time (Joos's *Lehrbuch der theoretischen Physik* is referred to). The purpose of the present work is "a concise survey of the most important theoretical results for media with arbitrary complex indices of refraction, as well as a description of the phenomena occurring at refraction, with particular attention to the relations holding when one of the two media is air and the other the ground. A paper by Houtsmuller [4227 of October] has recently appeared which deals with the refraction of plane waves at the surface of separation between air and sea-water: it has, however, no general character, being devoted specially to the conditions for sea-water, where the dielectric conduction is of subordinate importance. The results of Houtsmuller's paper are therefore not applicable to media with arbitrary complex refraction indices."

The analysis of the general case extends to p. 57. Approximate formulae (4, 5) are derived for the two specially interesting cases of preponderating conductivity σ_1 and preponderating dielectric conduction (large ϵ_1) of the first medium; their implications as regards velocity & attenuation (and hence the "penetration depth," at the end of which the amplitude has sunk to 1/534 of its original value) are discussed at the top of p. 54, and the curves of Figs. 2 & 3 deal with some combinations of σ_1 & ϵ_1 which are applicable to various types of terrain.

The treatment of the refraction process begins on p. 55. Since the refraction index between the two media is in general complex, the reflection and penetration coefficients (giving the change of amplitude immediately at the surface) are also complex: their phase angles, determining the temporal phase displacement of the components due to refraction, are, in general, different for horizontal and vertical polarisation, so that waves originally linearly polarised become elliptically polarised after refraction. The special case where the angle δ_2 (direction of propagation in the second medium) is real is briefly considered on p. 56; in general δ_2 is complex, and eqns. 15 to 22 are those of an inhomogeneous wave. This has the characteristics that in the direction of propagation the amplitude is not constant (eqn. 19) and the wavelength in the second medium is dependent on the direction of propagation (eqn. 19a): "on the other hand in the direction α_1, in which the amplitude is constant, the phase is not constant. The damping itself varies with the angle of incidence. These phenomena are linked to the fact that the damping exponent of the wave in the second medium (that is, the real part of the exponent) depends also on the conductivity of the first medium. Thus the decay of the wave depends not only on the constants of the medium in which it finds itself but also on the constants of the medium traversed before the refraction process."

A special case of practical importance is then investigated, where the conductivity of the first medium, σ_1, is zero (eqn. 23). As an example the passage of plane waves (polarised parallel to the surface of separation) from air into the ground is calculated numerically, and Figs. 5-8 show the calculated field strengths in the earth at different depths (to 5 or 10 metres) as a function of wavelength (20–100 m), for various combinations of ϵ_2 and σ_2 and for various angles of incidence. The implications of these are discussed (below eqn. 30): thus "at small depths the absorption increases with increasing wavelength, while at great depths it decreases with increasing wavelength. This phenomenon is a result of the combination of two effects: on the one hand the penetration coefficient [*see* above] becomes smaller as the wavelength increases, while on the other hand the depth, measured in wavelengths, becomes smaller, so that the absorption decreases. With short waves the absorption predominates, with long waves the reflection." Finally (Fig. 9) the field-strength values for a wave of 800 m are given as a function of depth, for three combinations of ground constants, for vertical incidence only. The decay of the waves is seen to increase as the conductivity increases.

4302. HIGH-FREQUENCY CHARACTERISTICS OF ROCKS.—Kadowaki. (*See* 4793.)

4303. REPORTS ON IONOSPHERIC CHANGES DURING A SOLAR ECLIPSE [Survey, covering Eclipses of 1935/6/7: Discussion of Results].—E. V. Appleton & R. Naismith. (*U.R.S.I. Proc. of* 1938 *Gen. Assembly*, Fasc. 1, Vol. 5, 1938, pp. 314–322.) In the writers' "Report of Ionospheric Sub-Commission of Commission II."

4304. THE ULTRA-VIOLET END OF THE SOLAR SPECTRUM [Poona Results].—M. W. Chiplonkar. (*Current Science*, Bangalore, July 1939, Vol. 2, No. 7, pp. 312–313.)

4305. THE CORRELATION BETWEEN IONISATION IN THE IONOSPHERE AND SUNSPOT NUMBERS [Correlation between F_2 Ionisation and Character Figure for Central-Zone Calcium Flocculi tentatively explained by Wavelength Considerations].—F. L. Mohler. (*Science*, 11th Aug. 1939, Vol. 90, pp. 137–138.)

4306. SMITHSONIAN SCIENTIST FINDS SUNSPOT CYCLE OF 89.36 YEARS: DISCOVERY MAY AID LONG-RANGE FORECASTING.—H. H. Clayton. (*Journ. Franklin Inst.*, Aug. 1939, Vol. 228, No. 2, p. 259: short note only.) *Cf.* 3455 of September.

4307. REMARKS ON THE RELATIONS BETWEEN SOLAR PHENOMENA AND THE PROPAGATION OF WAVES [and the Doubtful Existence of the 27-Day Period].—R. Jouaust. (*U.R.S.I. Proc. of* 1938 *Gen. Assembly*, Fasc. 1, Vol. 5, 1938, pp. 371–372: in French.) *Cf.* same writer, 3449 of September, and d'Azambuja, 3452 of September.

4308. SOLAR EFFECTS ON RADIO RECEPTION AT BROADCAST FREQUENCIES [Comparison of Field-Strength Curves with Sunspot-Numbers and Ultra-Violet Variations: F-S Increase with S-Ns up to 60–80 (Wolfer Scale), then a Decrease: Reflection & Absorption at E Layer dependent on More than One Critical Electron-Density Value? Auroral Maxima: etc.].—H. T. Stetson. (*U.R.S.I. Proc. of* 1938 *Gen. Assembly*, Fasc. 1, Vol. 5, 1938, pp. 381–383.)

4309. STATISTICAL DATA ON RAPID TOTAL FADINGS [at the Malnome (Rome) Receiving Centre, 1936/8, on Wavelengths 14–50 m].—(*U.R.S.I. Proc. of* 1938 *Gen. Assembly*, Fasc. 1, Vol. 5, 1938, pp. 335–348.)

4310. INCIDENT ANGLE OF SHORT WAVES AND HIGH-FREQUENCY NOISE [resembling "Grinders"] DURING DELLINGER EFFECT ["Output Method" of determining Angle of Incidence, using Two Horizontal $\lambda/2$ Aerials of Height $\lambda/2$ and $5\lambda/4$ respectively: Signal Angle always Varies, though sometimes Slightly: Noise Angle sometimes nearly 90°, becoming Lower as Noise decreases: Noise Source Not Local but in or near E Layer].—M. Nakagami & K. Miya. (*Electrot. Journ.*, Tokyo, Sept. 1939, Vol. 3, No. 9, p. 216.)

4311. DISTURBANCES OF WIRELESS PROPAGATION AND THE APPEARANCE OF SOLAR ERUPTIONS [Survey of Present Knowledge, with Nine Definite Conclusions: Points still requiring Solution].—B. Beckmann. (*E.T.Z.*, 10th & 17th Aug. 1939, Vol. 60, Nos. 32 & 33, pp. 945–948 & 982–985.)

4312. RADIOPHONIC PERTURBATIONS DURING THE POLAR AURORA OF 25TH JAN. 1938, IN SWITZERLAND [Marked Weakening, Distortion, Violent Atmospherics].—J. Lugeon. (*U.R.S.I. Proc. of* 1938 *Gen. Assembly*, Fasc. 1, Vol. 5, 1938, pp. 326–327: in French.) Even Swiss signals (over as little as 20 km) suffered diminution and quite abnormal fluctuations, suggesting that even direct waves are subjected to extra-terrestrial influences.

4313. EARLY OBSERVATIONS OF AURORA AUSTRALIS [1773/1898], *and* THE PHOTOGRAPHIC DETERMINATION OF THE HEIGHT AND POSITION OF AURORAE OBSERVED IN NEW ZEALAND DURING 1937 [Good Agreement with Heights obtained in Norway].—F. W. G. White: M. Geddes. (*New Zealand Journ. of Sci. & Tech.*, No. 5B, Vol. 20, 1939, pp. 267–271B: No. 6B, pp. 289–305B.)

4314. THE PRELIMINARY CALCULATIONS OF A BROADCASTING STATION.—(*See* 4747.)

4315. ON THE THEORY OF THE CEILING PROJECTOR [for measuring Cloud Heights at Night].—W. E. K. Middleton. (*Journ. Opt. Soc. Am.*, Aug. 1939, Vol. 29, No. 8, pp. 340–349.)

ATMOSPHERICS AND ATMOSPHERIC ELECTRICITY

4316. FLUCTUATIONS IN INTENSITY OF STATIC [Observations of Abrupt Diminution of Recorded Static Level at Certain Hours during the Night].—G. W. Kenrick & P. J. Sammon. (*Phys. Review*, 15th July 1939, Series 2, Vol. 56, No. 2, p. 203.)

4317. REPORT TO COMMISSION III ON BRITISH WORK ON ATMOSPHERICS, 1934/38, *and* REPORT OF SUB-COMMISSION 4 OF COMMISSION III: DIRECTION-FINDING ON ATMOSPHERICS.—R. A. Watson Watt. (*U.R.S.I. Proc. of* 1938 *Gen. Assembly*, Fasc. 1, Vol. 5, 1938, pp. 294–296: pp. 297–300.)

4318. THE ORIGIN OF THE H.F. NOISE DURING DELLINGER EFFECTS.—Nakagami & Miya. (In paper dealt with in 4310, above.)

4319. LIGHTNING FLASHES AND HIGH-TENSION MAINS [Damage caused by Thunderstorms during July].—(*Nature*, 5th Aug. 1939, Vol. 144, p. 239: short note only.)

4320. PARIS H.T. CONGRESS: X—ARTIFICIAL LIGHTNING RESEARCHES WITH MODELS.—T. Rich. (*Electrician*, 22nd Sept. 1939, Vol. 123, pp. 287–288.)

4321. "HOT" LIGHTNING, *and* LIGHTNING STROKES: RESULTS OF RECENT STUDIES IN FIELD AND LABORATORY.—P. L. Bellaschi. (*Electrician*, 15th Sept. 1939, Vol. 123, p. 270: pp. 271–272.)

4322. SPECIFIC IONISATION MEASUREMENTS AND SIGN PREFERENCE FOR CONDENSATION IN A WILSON CLOUD CHAMBER.—R. B. Brode & G. D. Bagley. (*Phys. Review*, 15th July 1939, Series 2, Vol. 56, No. 2, p. 209: abstract only.)

4323. CONDENSATION OF SUPERSATURATED VAPOURS ON IONS [Cloud-Chamber Measurements: Water and C_6H_5Cl condense first on Negative Ions, Some Alcohols on Positive Ions, Other Organic Liquids have No Preference: No Simple Connection with Magnitude of Dipole Moment: Discussion of Other Writers' Results].—L. Scharrer. (*Ann. der Physik*, Series 5, No. 7, Vol. 35, 1939, pp. 619–637.)

4324. ON THE DISINTEGRATION OF ATOMIC NUCLEI BY COSMIC RAYS [and the Birth of Mesotrons].—Filippov & others. (*Journ. of Phys.* [of USSR: replacing *Tech. Phys. of USSR*], No. 1, Vol. 1, 1939, pp. 51–65: in English.)

PROPERTIES OF CIRCUITS

4325. Remarks on "Report on the Present State of Knowledge concerning Fluctuation Voltages in Electrical Networks and Thermionic Tubes."—E. Spenke: Moullin. (*U.R.S.I. Proc. of* 1938 *Gen. Assembly*, Fasc. 2, Vol. 5, 1938, pp. 41–45: in French.) *See* p. 41, and 2788 of July.

4326. The Linear Characteristic [and Methods of obtaining It: by Anode-Circuit Resistance, Multiple Control in Multi-Grid Valves, Current-Dividing Control, the Combination of Differently Bent Characteristics (Figs. 11 and 12), and by "Current Damming" in Hexodes].—J. Bärisch. (*Funktech. Monatshefte*, July 1939, No. 7, pp. 199–204.) For the last method *see* Kleen, end of 4110 of 1937 and back reference.

4327. General [Operational] Method for the Calculation of Transient Phenomena in Radio Circuits.—G. Giorgi. (*Boll. del Centro Volpi di Elett.*, English Edition, Jan./March 1939, Year 2, No. 1, p. 53d: *U.R.S.I. Proc. of* 1938 *Gen. Assembly*, Fasc. 1, Vol. 5, 1938, p. 371—short note only, in Italian.)

4328. Resonance Curves of Regenerative Detector [Tests on Variation of Resonance Point with Magnitude of Input Oscillation, for Various Values of Curve-Equalising Resistance in Regenerative-Coil Circuit].—S. Kanazawa. (*Electrot. Journ.*, Tokyo, Aug. 1939, Vol. 3, No. 8, p. 187.)

4329. Contribution to the Study of the Parallel Working of Electric Generators.—V. Petrovich. (*Rev. Gén. de l'Élec.*, 29th July 1939, Vol. 46, No. 4, pp. 122–125.)

4330. The Influence of the Self-Inductance of Wound [Roll-Type] Condensers on their Impedance.—L. Linder & J. Schniedermann. (*E.T.Z.*, 6th July 1939, Vol. 60, No. 27, pp. 793–798.)

Authors' summary:—The value of the impedance of a condenser is seriously influenced at high frequencies by the part played by the inductive component. In considering the value of self-induction it is desirable to make a subdivision corresponding to the construction of a roll-type condenser; that is, to distinguish between the self-inductances of the actual roll element, of the connector strips, of the internal wiring and of the external leads. By dealing with the course of the current in each of these elements separately, it is usually possible to calculate the inductance with the help of known examples, and thus to give an informative equivalent-circuit diagram for the whole condenser.

4331. Condenser-Lead Resonance Chart [of Measured Values for Frequencies up to 40 Mc/s].—R. L. Haskins. (*Electronics*, Aug. 1939, Vol. 12, No. 8, pp. 35 and 36.)

4332. Frequency-Response Control Networks [with Simplified Calculations for Commercial Purposes].—B. Ephraim. (*Communications*, June 1939, Vol. 19, No. 6, pp. 12–13 and 32..34.)

4333. Series-Resonance Circuit, Coupled Circuits, and Band Filters [with New Exact Formulae: Application to Needle-Scratch and Television Filters].—E. de Gruyter. (*Bull. Assoc. suisse des Élec.*, No. 19, Vol. 30, pp. 637–644: to be contd.) Further development of the "reciprocal representation" methods dealt with in 1840 of May.

4334. A Band-Pass Filter of Variable Width with Constant Form-Factor and Middle Frequency.—G.W.O.H: Alsleben & Weiler. (*Wireless Engineer*, Aug. 1939, Vol. 16, No. 191, pp. 381–382.) Editorial on paper dealt with in 3090 of August.

4335. Electric Filters: Band Widths and Time Constants.—P. Nicolas. (*Rev. Gén. de l'Élec.*, 8th July 1939, Vol. 46, No. 1, pp. 27–30.)

"What is the origin of the usual notion of a relation between the band width and the time constant in a filter? It lies in an extension of the properties of the simplest filters . . . But one can no longer reason in this simple manner when dealing with a more complex system . . ." The writer quotes, as an example, the simple case of a filter in the Wheatstone-bridge connection, which has an infinite band width and yet quite a long time constant.

4336. Wave Filters using Magnetostriction Resonators [replacing Quartz for Frequencies below 50–60 kc/s: using Laminated Element of Very Thin Nickel Foils stuck together, to avoid Magnetic Skin Effect and Eddy-Current Loss].—K. Fukushima & T. Koitibara. (*Electrot. Journ.*, Tokyo, July 1939, Vol. 3, No. 7, p. 168.)

4337. Multi-Winding Magnetostriction Vibrator [primarily for Wave Filters].—T. Hayasaka. (*Nippon Elec. Comm. Eng.*, July 1939, No. 17, pp. 51–52: short summary only.)

4338. Filters employing YT-Cut Quartz Plates.—Yoda & Kato. (*See* 4389.)

4339. New Methods of designing Electrical Wave Filters ["Duplex Ladder-Type" and "New Type Filter having Highly Improved Image Impedance Characteristic"].—A. Matsumoto & M. Saisyo. (*Nippon Elec. Comm. Eng.*, July 1939, No. 17, pp. 18–23: *see* also p. 54.) For previous work on "doublet" filters *see* 1934 Abstracts, pp. 435–436.

4340. Simple Improvements in R-C Power-Supply Filters [Addition of Auxiliary Balancing Resistance (R_B in Figs. 2 & 3): Successful Use in Several Applications where Low Cost, Light Weight, and Freedom from Magnetic Interference are Important].—H. H. Scott. (*Electronics*, Aug. 1939, Vol 12, No. 8, pp. 42..48.)

4341. Designing the Smoothing Filter of the Rectifier.—T. Yokoyama. (*Nippon Elec. Comm. Eng.*, May 1939, No. 16, p. 633 : short summary only.)

4342. Analysis of Frequency Multiplier [using Triode Valve : Treatment by Comparison with Class C Amplifier : Charts for Design : Multi-Electrode Valve as Special Case].—H. Uchida. (*Electrot. Journ.*, Tokyo, July 1939, Vol. 3, No. 7, pp. 156–164.)

4343. An Operational Treatment of the Design of Electro-Magnetic Time-Base Amplifiers.—Jofeh. (*See* 4581.)

4344. Amplifier Band-Width : Simplitude Principles.—S. Ramo. (*Communications*, May 1939, Vol. 19, No. 5, pp. 16 and 33, 34.

4345. The Calculation of the Lower Frequency Limit of Resistance-Coupled Amplifiers.—H. Pitsch. (*Funktech. Monatshefte*, July 1939, No. 7, pp. 213–214.) For previous papers *see* 462/463 of February.

4346. Clarification of Symbols in "The Input Impedance of Self-Biased Amplifiers."—F. C. Williams. (*Wireless Engineer*, July 1939, Vol. 16, No. 190, p. 350.) *See* 2860 of July.

4347. A Study of Feedback Amplifiers by their Equivalent Circuits [for Current, Voltage, & Compound Negative Feedback : also Duplex Feedback].—Y. Watanabe & S. Okamura. (*Nippon Elec. Comm. Eng.*, July 1939, No. 17, pp. 10–17.)

4348. On the Effect of Regenerative Feedback in the Duplex Feedback Amplifier.—K. Kobayashi. (*Nippon Elec. Comm. Eng.*, July 1939, No. 17, p. 50 : short summary only.)

4349. Grid-Blocking [by Momentary Signal-Peaks] in RC Amplifiers : Its Cause and Cure.—(*Wireless World*, 21st Sept. 1939, Vol. 45, pp. 273–274.)

4350. A "Hard" Valve Electronic Relay Switch [for Simultaneous Delineation on C-R Oscillograph : Switching Frequencies 15–13 000 c/s].—W. K. Clothier. (*Journ. of Scient. Instr.*, Sept. 1939, Vol. 16, No. 9, pp. 285–290.)

4351. Trigger Circuits [Survey of Various Types, with Some Applications : including Literature References].—H. J. Reich. (*Electronics*, Aug. 1939, Vol. 12, No. 8, pp. 14–17.)

TRANSMISSION

4352. Space Charge and Field Waves in an Electron Beam [Theoretical Study of Slow Space-Charge Waves in (1) Very High Magnetic Focusing Field, (2) Absence of Magnetic Focusing Field : Existence of Fast "Field Waves" in Idealised Tube].—S. Ramo. (*Phys. Review*, 1st Aug. 1939, Series 2, Vol. 56, No. 3, pp. 276–283.)

For "space charge" waves *see* Hahn, 3521 of September and back reference. In the present paper, "space charge" waves are defined as those in which "phase velocities are close to beam velocity and the wave energy is mainly in the electrons." For "field waves," "the phase velocities are large compared to beam velocity and the energy is mainly in the electromagnetic field."

4353. Oscillation Generation by a Cathode Ray in the Field of a Plate Condenser.—Thoma. (In paper dealt with in 4644, below.)

4354. Influence and Control of the Form of the Charges moving Periodically in Electron Valves, particularly in the Shock Excitation of [Ultra-] Short-Wave Oscillations.—G. Jobst. (*Telefunken-Hausmitteilungen*, July 1939, Vol. 20, No. 81, pp. 84–96.)

"With increasing frequencies the direct control of the discharge current becomes more and more hindered by the inertia of the electrons; in the centimetric-wave region it becomes impossible, for practical values of electrode-spacing and voltages. The paper describes a shock-excitation and frequency-multiplication method whose principal feature is the compression of a large charge, arising from a cathode during a comparatively long discharge time, into electron "bunches" strongly compressed in time, through whose transit in the discharge space sharply defined current pulses are produced with a high harmonic content." The simplified theoretical arrangement shown in Fig. 115 is first considered, where K is a cathode emitting (or allowing to pass through, with low velocity) a periodic succession of short-time charges, A a penetrable (*e.g.* grid-type) anode positive with respect to K, and P a collector electrode with weak positive potential. The mathematical discussion of this arrangement, particularly the influence of the various factors on the fundamental and harmonic contents of the anode current and on the "repeatability" (that is, the reciprocal of the spacing of the successive charges which is most favourable as regards amplitude), lead to the determination of the optimum relations, for ultra-short-wave generation, of the controlling factors, and thus to the requirements of the control and emission mechanism of the cathode.

Treatment on pp. 93–94 of the emergence of the electron "bunch" from the compression zone into a zone with a different field-distribution law leads to the complete scheme of shock-excitation seen in Fig. 129. Here the space between K' and K_0 is the "pre-control" space. G' is given, in addition to a weak negative bias with respect to K', the precontrol voltage of frequency $\omega/2\pi = 1/z$; G'' has a positive voltage with respect to K'. K_0 and K' are at about the same voltage. The voltage G_1 & G_2 is the compression voltage, which (as explained in section B.iii) is compounded of a direct voltage and an a.c. voltage of frequency also $\omega/2\pi = 1/z$. $1/z$ is chosen as large as possible; that is, the "repetition period" z of the pulses is made as small as possible. The perforated anode A has a high d.c. voltage on which is superposed the a.c. voltage coming from the load circuit (the closed $L\,C$ circuit shown in the figure) of its own resonance frequency $\Omega/2\pi = n/z$, where n is 1, 2, 3 . . . ; at P, the collector electrode, there is a weak positive voltage. The reference potential for the whole scheme is that of G_2, which actually acts as the working pulse-emitting cathode for the arrangement.

The action is as follows :—The electrons emerge from K' into the pre-control space $K'K_0$ only during such a part of the total period z as corresponds to the extent of the "coincidence zone" ("Übereinstimmungsbereich"; *see* pp. 92–93). The phases of the voltages at G' and in the space $G_1 G_2$ are so chosen that the electrons passing through K_0 occupy the space K_0G_1 during the coincidence time only. The electrons begin already in the space K_0G_1 to catch each other up, and in the space G_1G_2 they run together to such an extent that they enter the true "working space" G_2AP as strongly compressed "bunches." The frequency-multiplication factor, $n = \Omega z/2\pi$, can be chosen the higher, the greater the compression of the "bunches."

Section B.vi deals briefly with factors liable to limit the attainable frequencies: it is suggested among other things that in certain cases a step-by-step compression may be desirable. The final section refers briefly to the processes described above as seen from the view-point of "velocity modulation" (reference is made to Hahn & Metcalf's work, 1901 of May) and to the question of the possible application of such control to ionic tubes; for while the usual modulation methods require definite field strengths, for interrupting the current, which are unattainable at high frequencies (owing to the ion clouds near the cathode, which at such frequencies must be regarded as constant in time), velocity modulation requires for interruption simply a definite temporal field-strength variation at the cathode.

4355. Study of the Motion of Electrons in Positive-Grid Triodes.—C. Biguenet & J. Consigny. (*Rev. Gén. de l'Élec.*, 5th Aug. 1939, Vol. 46, No. 5, pp. 145–152.)

Following on the paper dealt with in 3895 of 1938; *see* also 1828 of 1938. The writers show by a mechanical analogy (rubber-membrane technique) "the diversity of the electron trajectories contributing to the production of oscillations, and study, from the mathematical point of view, the simplest of these trajectories. It is, however, necessary in this study to make certain approximations which lead to possible errors of the order of 3%. They then show that the phenomenon of oscillation at the grid is due to a shock, electromagnetic in nature, caused by the passage of the electrons between two wires of the grid; and they deduce from this the reason why it is possible to obtain several régimes with the same wavelength with one and the same valve [the first régime, for a weak negative plate potential, corresponds to $k = T_e/T_g = 5$; the second, for a high negative potential, to $k = 3$; a régime with $k = 1$, for an extremely high negative plate potential, should be possible but is very difficult to obtain experimentally owing to the delicacy of adjustment]. An experimental study confirms the exactness of the calculations and of the various hypotheses, for a number of valves with and without the use of a magnetic field."

4356. Generation of Ultra-High-Frequency Radio Waves by Electronic Oscillations [Investigations on B-K Oscillations in G-M Modification of B-K Circuit: Emission Current as Important as Grid Potential in determining Wavelength: New Formula $\lambda E_g^{\frac{1}{2}} I_e^{\frac{1}{3}} =$ constant].—S. S. Banerjee & A. S. Rao. (*Sci. & Culture*, Calcutta, July 1939, Vol. 5, No. 1, pp. 64–65.) The wavelengths were 106–174 cm. For the decrease of λ with increase I_e *see* also Gill, 3923 of October.

4357. Experiments on the Grid Spiral Oscillations [External Circuit connected to Ends of Helical Grid (Not Short-Circuited) of Triode: Wavelengths 13–30 cm by varying Circuit: Increased Output under Certain Conditions by Use of Magnetic Field].—M. Kobayasi & Y. Moriwaki. (*Nippon Elec. Comm. Eng.*, May 1939, No. 16, pp. 591–595.)

4358. Triode Oscillators for Ultra-Short Wavelengths [Circuit and Transit-Time Limitations of Negative-Grid Triodes: Plan of making Anode & Grid as Integral Parts of Concentric Line: Approx. Theory of Class C Oscillators at Onset of Transit-Time Effects: Wavelengths around 10 cm Not Impossible: etc.].—M. R. Gavin. (*Wireless Engineer*, June 1939, Vol. 16, No. 189, pp. 287–295.) Work of the research staff of the M.O. Valve Company.

4359. High-Power Generation at Ultra-High Frequency by means of Back Coupling [Experiments using LD-22-E Valves in Push-Pull Circuits, with Coaxial Heating-Current Leads (Adjustable Impedance): 25.2 kW Input, 8.4 kW Output, on 2.2 m Wave].—M. Kobayashi & H. Nisio. (*Electrot. Journ.*, Tokyo, Aug. 1939, Vol. 3, No. 8, p. 189.)

4360. Theory of Asymmetrically Split Magnetrons [Conditions for "B-Type" Oscillations].—M. Hisida. (*Electrot. Journ.*, Tokyo, June 1939, Vol. 3, No. 6, p. 144.)

4361. Magnetron as a Constant-Current Oscillator [Mathematical Discussion of Static Induction of Electron Motion in Split-Anode Magnetron, giving Oscillations of First and a Higher Order: Effect of tuning External Circuit to Latter: Constant Current if E_a and λ are Constant].—G. Hara. (*Electrot. Journ.*, Tokyo, Sept. 1939, Vol. 3, No. 9, pp. 214–215.)

4362. Amplitude Modulation of the "Osaka" Tube having a Mesh Grid [giving High-Percentage Modulation with Reduced Interference from Secondary Electrons and Little Frequency Modulation].—F. Baba. (*Nippon Elec. Comm. Eng.*, July 1939, No. 17, p. 53: short summary only.) For the Osaka micro-wave valve *see* 3897 of 1938 and back references.

4363. ULTRA-SHORT-WAVE OSCILLATORS.—Black. (*See* 4444.)

4364. EXPERIMENTAL ULTRA-SHORT-WAVE TRANSMITTER [100–150 Mc/s, Power 200 W].—J. S. McPetrie & C. G. Carter. (*Wireless Engineer*, July 1939, Vol. 16, No. 190, pp. 340–343.)

4365. FREQUENCY-STABILISING TUNER FOR ULTRA-SHORT-WAVE TRANSMITTER.—H. Utida [Uchida]. (*Nippon Elec. Comm. Eng.*, May 1939, No. 16, pp. 633–634: summary only.) The full paper was dealt with in 3927 of October.

4366. HIGH-Q TANK CIRCUIT FOR ULTRA-HIGH FREQUENCIES [Two Types for $1\frac{1}{4}$ m, One Each for $2\frac{1}{2}$ & 5 m, All on Design of Squat Cylinder supported Coaxially inside Larger Squat Cylinder by Central Rod].—A. Peterson. (*QST*, Sept. 1939, Vol. 23, No. 9, pp. 19–26.)

4367. COMPARISON OF VARIOUS STABILISERS FOR DECIMETRIC WAVES [Kolster Tank, Resonant Line, & Ellipsoidal Tank: Superiority of the Last, and Its Design].—K. Morita & K. Hayasi. (*Nippon Elec. Comm. Eng.*, July 1939, No. 17, pp. 6–9.)

4368. AN ANSWER TO THE ELECTRON-COUPLED OSCILLATOR PROBLEM [Electron-Coupled Exciter covering the Whole 14-Mc/s Band, with a Crystal Control at Each Edge].—C. D. Perrine, Jr. (*QST*, Sept. 1939, Vol. 23, No. 9, pp. 14–18.)

4369. 500-WATT BEAM-POWER-TUBE CRYSTAL OSCILLATOR [using the D-2045: No Overloading of Crystal with Output of 500 W or more at 5 Mc/s].—C. Miyauti & T. Sasaki. (*Electrot. Journ.*, Tokyo, Aug. 1939, Vol. 3, No. 8, p. 189.)

4370. NEW "SPOT WAVE" SERIES OF COMMERCIAL RADIO TRANSMITTERS [Type E: Five Equipments in Short-Wave Band, Four in Medium/Long].—(*Elec. Communication*, July 1939, Vol. 18, No. 1, pp. 57–59.)

4371. A PORTABLE EMERGENCY UTILITY TRANSMITTER [weighing $14\frac{1}{2}$ lb, driven by 6-Volt A.C. or D.C. Supply].—L. F. Leuck. (*QST*, Sept. 1939, Vol. 23, No. 9, pp. 30–32 and 55.)

4372. THE "RUNT SIXTY" AND THE "QSL SIXTY" [Former small enough to go into Overcoat Pocket, Crystal Controlled: 60 W Output on 80 & 40 m, Slightly Less on 20 m].—F. Sutter. (*QST*, Sept. 1939, Vol. 23, No. 9, pp. 50–52 and 108, 110.)

4373. FUNDAMENTAL CONSIDERATIONS ON FOUR-PHASE OSCILLATION CIRCUITS.—I. Takao. (*Rep. of Rad. Res. in Japan*, [dated] Dec. 1938, Vol. 8, No. 3, Abstracts p. 17.)

4374. HIGHLY-DAMPED RADIO TRANSMISSION METHOD FOR INTERFERENCE TRANSMISSIONS.—S.A.F.A.R. & A. Castellani-Milano. (*Boll. del. Centro Volpi di Elett.*, English Edition, Jan./March 1939, Year 2, No. 1, p. 133d.)

4375. ON AN EXPERIMENT OF PRODUCING SINGLE SIDEBAND [Attempt to find Practical System using Cancellation Principle for Suppression: Success to more than −40 db].—T. Nakai & I. Oguma. (*Nippon Elec. Comm. Eng.*, May 1939, No. 16, pp. 587–590.)

4376. ON THE SPECIAL PROPERTIES OF THE BROADCASTING TRANSMITTER BY THE METHOD OF HIGH-POWER MODULATION.—M. Kono. (*Rep. of Rad. Res. in Japan*, [dated] Dec. 1938, Vol. 8, No. 3, Abstracts p. 18.)

4377. A HIGH-EFFICIENCY MODULATING SYSTEM.—A. W. Vance. (*Proc. Inst. Rad. Eng.*, Aug. 1939, Vol. 27, No. 8, pp. 506–511.) A summary was dealt with in 3525 of 1938.

4378. INCREASED OUTPUT WITH GRID-BIAS MODULATION [Raising the Modulation-Peak Efficiency to improve Valve Utilisation].—J. A. McCullough. (*QST*, Sept. 1939, Vol. 23, No. 9, pp. 40–42 and 108.)

4379. BETTER 'PHONE OPERATION WITHOUT "SPLATTER" [A.F. Distortion as Source of "Splatter" almost as Important as Over-Modulation: Modulation Transformer Circuit to act as Filter].—J. R. Bain. (*QST*, Sept. 1939, Vol. 23, No. 9, pp. 43–47 and 92, 94.)

4380. A POLAR VARIABLE-PHASE OSCILLATOR [Phase Angle variable by 0–180° without Change of Amplitude & Frequency].—I. Takao. (*Electrot. Journ.*, Tokyo, May 1939, Vol. 3, No. 5, pp. 109–112.)

4381. APPLYING [Inverse] FEEDBACK TO BROADCAST TRANSMITTERS [for Improvement of Noise and Distortion Characteristics of Existing Equipment].—L. G. Young. (*Electronics*, Aug. 1939, Vol. 12, No. 8, pp. 20–27.)

4382. ANTI-HARMONIC FILTERS [for Transmitters].—A. G. Chambers & W. Bacon. (*Wireless World*, 28th Sept. 1939, Vol. 45, pp. 295–296.)

RECEPTION

4383. A NEW RECTIFYING MECHANISM FOR CENTIMETRIC WAVES.—O. Döhler & C. Hecker. (*Hochf:tech. u. Elek:akus.*, July 1939, Vol. 54, No. 1, pp. 7–11.)

Rectification of centimetric (13.66 cm) waves by ordinary diodes for the broadcasting range is found to be best in the straight part of the characteristic (Fig. 1). This is found to be due to a transit-time mechanism between the cathode and the potential minimum in the valve (*not* between the cathode and the anode); the theory of this is developed in § II, where calculations show that the transit time between these two points is of the same order of magnitude as the rectified frequency. § III describes experiments (circuit Fig. 6) showing that the optimum rectification is independent of the anode radius but varies with the frequency, the surface of the filament, and the saturation current.

4384. FREQUENCY-MODULATION: THEORY OF THE FEEDBACK RECEIVING CIRCUIT, *and* THE APPLICATION OF NEGATIVE FEEDBACK TO FREQUENCY-MODULATION SYSTEMS.—J. R. Carson : J. G. Chaffee. (*Bell S. Tech. Journ.*, July 1939, Vol. 18, No. 3, pp. 395–403 : pp. 404–437.)

(1) Continuation of the paper dealt with in 464 of 1938, and companion paper to (2), which was dealt with in 3120 of August.

4385. DUAL-DIVERSITY RECEPTION SIMPLIFIED [Accessory Unit for Existing Superheterodyne Receiver, with Aerial Selection by Rotating Differential Condenser], *and* SIMPLIFIED DUAL-DIVERSITY RADIOTELEGRAPH RECEPTION [Two Spaced Aerials, each with Its Own R.F. Amplifier Stage, switched alternately to Common Receiver by 360 c/s Multivibrator].—McM. Silver: F. A. Bartlett. (*Electronics*, March 1939, Vol. 12, No. 3, pp. 66 and 68 : Aug. 1939, No. 8, pp. 48 and 50.)

4386. DIVERSITY WITH WHAT YOU HAVE [Simple Use of Two Receivers to reduce Fading].—S. G. Taylor. (*QST*, Sept. 1939, Vol. 23, No. 9, pp. 56–57.)

4387. COMPARISON OF FADING CHARACTERISTICS: TUNED BEAM ANTENNAS *versus* HALF-WAVE DIPOLES.—Nakagami & Akazawa. (*See* 4439.)

4388. ON THE ELIMINATION OF [Round-the-World] ECHO SIGNALS BY MEANS OF A LONG-WIRE ANTENNA [Successful Results, Effective Elimination over Wide Range of Frequencies compared with Tuned Beam Receiving Aerial].—M. Nakagami & K. Miya. (*Nippon Elec. Comm. Eng.*, May 1939, No. 16, pp. 604–614.)

4389. FILTERS EMPLOYING YT-CUT QUARTZ PLATES [Low Temperature-Coefficient Plates cut Parallel to Mechanical Axis, making 40–45° with Optical Axis: Characteristics of I.F. Band-Pass Filters and Comparison with Commercial Transformer-Type Filter: Use in Superheterodyne Receiver].—H. Yoda & B. Kato. (*Electrot. Journ.*, Tokyo, June 1939, Vol. 3, No. 6, pp. 142–143.)

4390. MORE ABOUT AMATEUR INTERFERENCE WITH BROADCASTING [Some "Case Histories" and Suggestions].—G. E. Gustafson. (*QST*, Sept. 1939, Vol. 12, No. 9, pp. 53–55.)

4391. ON THE INFLUENCE OF THE AERIAL COUPLING ON SENSITIVITY AND SELECTIVITY.—F. Benz. (*Funktech. Monatshefte*, June 1939, No. 6, pp. 180–182.)

4392. HETROFIL—AN AID TO SELECTIVITY: AN AUDIO "PHASING-OUT" SYSTEM FOR ELIMINATING HETERODYNE INTERFERENCE [Unit plugging into Telephones Circuit: on Wien A.C. Bridge Principle].—R. W. Woodward. (*QST*, Sept. 1939, Vol. 23, No. 9, pp. 11–13 and 90.)

4393. INPUT CONTROL CIRCUIT [Automatic Signal-Limiting Circuit successfully applied to High-Fidelity Receiver].—W. W. Waltz. (*Electronics*, March 1939, Vol. 12, No. 3, pp. 38 and 40, 42.)

4394. AUTOMATIC THRESHOLD CONTROL ["Quiet Tuning" & Other Advantages] FOR RADIO-TELEGRAPH AND TELEPHONE RECEIVERS.—L. Hollingworth. (*Communications*, June 1939, Vol. 19, No. 6, pp. 10–11 and 14.)

4395. FREQUENCY-RESPONSE CONTROL NETWORKS [with Simplified Calculations for Commercial Purposes].—B. Ephraim. (*Communications*, June 1939, Vol. 19, No. 6, pp. 12–13 and 32. .34.)

4396. INFLUENCE OF PARASITIC PHENOMENA ON THE REPRODUCTION OF ACOUSTICAL FREQUENCIES WITHIN RECEIVING SETS.—P. P. Di Roberto. (*Boll. del Centro Volpi di Elett.*, English Edition, July/Sept. 1938, Year 1, No. 3, p. 95d.)

4397. PARASITIC OSCILLATION IN [Short-Wave] FREQUENCY-CHANGERS.—J. A. Sargrove. (*Wireless World*, 10th Aug. 1939, Vol. 45, pp. 121–124.)

4398. NOISE REJECTION CIRCUITS.—W. Russell. (*Electronics*, May 1939, Vol. 12, No. 5, pp. 38 and 40, 42.)

4399. MEASUREMENTS OF THE RANGE OF BROADCAST RECEPTION DISTURBANCES DUE TO ULTRA-SHORT-WAVE MEDICAL TREATMENT APPARATUS.—F. Conrad & H. Schäffer. (*Hochf:tech. u. Elek:akus.*, July 1939, Vol. 54, No. 1, pp. 5–7.)

These experiments were carried out in a district where there were no electrified wires or cables or other sources of disturbances except those used in the experiments. These were a valve apparatus working on a frequency of 47 Mc/s and a quenched-spark-gap apparatus. Their frequency spectra measured at 300 m distance are shown in Fig. 1; the interference voltages were measured on a 2 m vertical aerial with the interfering apparatus (1) outside a screening cage, (2) inside the cage, with a choke on the mains. The results as a function of distance, on a frequency of 47 Mc/s, are shown in Fig. 2 and compared with the disturbance due to a modulated short-wave emitter with a half-wave dipole, set up in a building. Fig. 3 gives the measured disturbance on a frequency of 43 Mc/s. The disturbances were found to be so large that it is recommended to surround both apparatus and patient with a complete metallic screen, and choke all leads into the screened space, if television reception is to be reasonably free from disturbance.

4400. CAPACITY COMPONENT OF IGNITION-COIL DISCHARGE.—Mochizuki & others. (*Electrot. Journ.*, Tokyo, Aug. 1939, Vol. 3, No. 8, pp. 187–188.)

4401. INTERFERENCE FROM ELECTRIC RAZORS: ITS NATURE AND CURE.—J. E. M. Coombes. (*Wireless World*, 14th Sept. 1939, Vol. 45, pp. 259–261.)

4402. "RADIO INTERFERENCE SUPPRESSION" [Book Review].—G. W. Ingram. (*Electrician*, 22nd Sept. 1939, Vol. 123, p. 290.)

4403. EXPERIMENTS ON RADIO TELEPRINTER [Start-Stop Type, with the "M.T.T." Type X-Eliminator (using Thyratrons): between Hsinking & Harbin].—T. Sugiyama & M. Nakata. (*Nippon Elec. Comm. Eng.*, May 1939, No. 16, pp. 629–630: summary only.) *See* also 2318 of June.

4404. WIRELESS IN THE TROPICS [More Damage done by Surges induced into Mains than by Direct Strokes to Aerial: etc.].—(*Wireless World*, 14th Sept. 1939, Vol. 45, p. 254.)

4405. THE MECHANICS OF RECEIVER DESIGN: TEMPERATURE, HUMIDITY, VIBRATION.—(*Wireless World*, 7th Sept. 1939, Vol. 45, No. 10, pp. 235–237.)

4406. WHY COMPONENTS FAIL: RELATIVE SUSCEPTIBILITY TO BREAKDOWN.—W. H. Cazaly. (*Wireless World*, 7th Sept. 1939, Vol. 45, No. 10, pp. 228–230.)

4407. VOLTAGE-DROPPING RESISTANCE [in "Midget" Sets]: POSSIBLE DANGERS—AND A REMEDY.—J. Bland. (*Wireless World*, 7th Sept. 1939, Vol. 45, No. 10, p. 245.)

4408. "PRINCIPLES AND PRACTICE OF RADIO SERVICING" [Book Review].—H. J. Hicks. (*Wireless Engineer*, Aug. 1939, Vol. 16, No. 191, p. 402.)

4409. POWER FROM THE WIND: ITS USES FOR ACCUMULATOR CHARGING.—Beatt. (*Wireless World*, 21st Sept. 1939, Vol. 45, pp. 271–272.) For a previous paper on receiver power supply *see* 1887 of May: *cf.* also 3786 of September.

4410. HEADPHONE LISTENING FOR WAR-TIME CONDITIONS [with Components & Circuits for Adaptor Units].—R. H. Wallace. (*Wireless World*, 21st Sept. 1939, Vol. 45, pp. 268–270.)

4411. RECEIVER CHARACTERISTICS OF SPECIAL SIGNIFICANCE TO BROADCASTERS.—D. E. Foster. (*Communications*, May 1939, Vol. 19, No. 5, pp. 9–13 and 36, 37.)

4412. REPRODUCTION LEVELS [and the Preservation of Tonal Balance: Discussion].—(*Wireless World*, 17th Aug. 1939, Vol. 45, p. 160.) Recapitulation of a discussion in previous issues. *See* also issue of 24th Aug. 1939, p. 183 (Voigt).

4413. THE *Wireless World* PRE-SET QUALITY RECEIVER.—(*Wireless World*, 17th & 24th Aug. 1939, Vol. 45, pp. 140–144 & 184–186.) *See* also *Wireless Engineer*, Aug. 1939, Vol. 16, No. 191, p. 390.

4414. NEW HIGH-FIDELITY RECEIVER.—(*Communications*, May 1939, Vol. 19, No. 5, pp. 14–15 and 35, 36.)

4415. HIGH-QUALITY RADIO RECEPTION [Design of Special Receiver].—J. Walsh. (*Electronics*, July 1939, Vol. 12, No. 7, pp. 20–23.)

4416. STANDARDISATION OF TESTS ON RECEIVERS [particularly the Question of Whistles due to Harmonics created by Input Stages and to Retroaction by Detector Circuits].—(*L'Onde Élec.*, July 1939, Vol. 18, No. 211, pp. 327–332.) Continued from 3135 of August.

4417. A SURVEY OF THE GERMAN BROADCAST RECEIVERS OF THE 1939/40 SEASON.—R. Moebes. (*T.F.T.*, July 1939, Vol. 28, No. 7, pp. 277–287.)

4418. IMPRESSIONS OF OLYMPIA [the Export Section: Band-Spreading: etc.].—(*Wireless World*, 7th Sept. 1939, Vol. 45, No. 10, pp. 231–232.)

4419. CONSTANT-FREQUENCY SUPERHETERODYNE RECEIVER [Oscillator Frequency fixed at That of I.F. Transformers: Advantages claimed].—B. Dueño. (*Electronics*, Aug. 1939, Vol. 12, No. 8, p. 38.) Some of the text seems obscure, possibly mutilated; but a circuit diagram is given and the action explained.

4420. MODERN DETECTOR CIRCUITS [Advantages and Limitations: the Diode Detector fed from a Cathode-Follower: etc.]—W. T. Cocking. (*Wireless World*, 10th & 17th Aug. 1939, Vol. 45, pp. 132–134 & 153–155.)

AERIALS AND AERIAL SYSTEMS

4421. TELEVISION RECEIVING AERIALS.—H. O. Roosenstein. (*Telefunken-Hausmitteilungen*, July 1939, Vol. 20, No. 81, pp. 13–24.)

Author's summary:—"The most desirable form for a television receiving aerial is the rod antenna, with coaxial cable leading to the receiver, which is common in sound broadcasting. For the reception of the ultra-short waves of television, however, this arrangement cannot be adopted without modification. The reason for this is the appearance of resonance oscillations in the outer current-carrying layer of the cable sheath ('sheath waves' [bottom of p. 16 onwards, with Fig. 12]). A form of aerial is given which displays this disturbing phenomenon only to a very small degree [Figs. 13–15: the suppressing aerial, at right angles to the true aerial, is also tuned, by series inductances, to the signal waves]. It is satisfactory in most practical conditions of reception. In situations where there are sources of interference close to the receiving cable, a heightened protection against 'sheath waves' becomes necessary. Two improved designs [Figs. 18 & 19] are suggested for this purpose. Finally a directional aerial is described, allowing an effective suppression of interference having a wide frequency band, such as ignition interference, owing to its reception minimum being very pronounced and its position independent of the frequency" [Fig. 20, showing the simple two-dipole directional aerial modified by a cross-over in the connections so that the end of the cable is no closer to the lower halves than to the upper; and Fig. 24, the final practical design embodying "$\lambda/4$ rejector pot" of Fig. 19 for the elimination of the "sheath waves"]. The final section deals with wide-band reception and the possibilities and limitations of widening the frequency characteristic of television aerials by means of special devices.

4422. THE "UNIT" TELEVISION BROADCAST RECEIVING AERIAL.—H. O. Roosenstein. (*T.F.T.*, July 1939, Vol. 28, No. 7, pp. 271–276.)

The theoretical considerations are taken from the author's paper dealt with in 4421, above. The two sloping rods shown in the present illustrations form the "sheath-wave" suppressor referred to in that paper: the sloping arrangement was adopted not for electrical reasons but to discourage birds from settling and to decrease the trouble of ice-formation.

4423. NEW TELEVISION AERIAL ["Tilted-Wire" Aerial, Easier to Install and Less Conspicuous: Anti-Interference Properties].—(*Wireless World*, 31st Aug. 1939, Vol. 45, pp. 206–207.)

4424. SHUNT-EXCITED ANTENNA USED BY ULTRA-HIGH-FREQUENCY STATION [W9XUP, on 26150 kc/s].—D. M. Miller. (*Electronics*, May 1939, Vol. 12, No. 5, pp. 44 and 46.)

4425. NEW EXPERIMENTS WITH THE "EARTH AERIAL" ON SHORT WAVES.—O. Schäfer. (*Hochf:tech. u. Elek:akus.*, July 1939, Vol. 54, No. 1, pp. 1–5.)

This aerial consists of two equal wires on or just above the ground (Fig. 1) with an emitter or receiver at the mid-point. It is here found to have certain advantages over short vertical aerials for short-wave work, which are particularly useful with transportable apparatus. It differs from a dipole in that its effect at a distance is greatest in the direction of its axis. Its electrical properties above ground of varying dielectric constant and conductivity are discussed; on ground of average conductivity it is found to behave like a frame aerial whose upper part is the wire, while the rest is represented by the current system in the ground. It is found that "the dimensions and radiation properties of the earth aerial become more favourable as the wavelength decreases, but the earth absorption increases markedly and has a deleterious effect on the action at a distance. At about 10 Mc/s the earth aerial is as good as the short vertical aerials used for transportable apparatus. The drier the ground, the longer the optimum wavelength, in general." Its loss resistance is greater than that of the short vertical aerial, but its capacity is practically independent of objects in its neighbourhood, so that an emitter connected to it has great frequency stability. Field-strength measurements are described in § II (emitter circuit Fig. 2) and shown in Fig. 3. The results agree with theoretical considerations (§ III).

4426. ON FRAME RECEIVING AERIALS [particularly in Field-Strength Measurement: the Importance of the "Q" Value: Measurement by Comparison with Standard Oscillator: Tests on Induced E.M.Fs and "Q" for Variously Wound Frames: Verification of Effective-Height Formula: etc.].—R. Koch. (*U.R.S.I. Proc. of* 1938 *Gen. Assembly*, Fasc. 1, Vol. 5, 1938, pp. 361–371: in Italian.)

4427. EFFECTIVE HEIGHT [Term tends to become Meaningless: Dependence also on Input Impedance of Receiver].—F. R. W. Strafford. (*Wireless World*, 31st Aug. 1939, Vol. 45, pp. 209–210.)

4428. HIGH-FREQUENCY FEEDERS CONSISTING OF THREE PARALLEL CONDUCTORS [Defects of Parallel & Concentric Pairs for Ultra-High Frequencies: Superiority of New Feeder in Smaller Radiation Resistance & Easier Construction].—K. Morita. (*Electrot. Journ.*, Tokyo, July 1939, Vol. 3, No. 7, pp. 164–166.)

4429. COAXIAL LINE INSTALLATION [Practical Review of Problems of Above- and Below-Surface Installations: including Protection from Lightning and Sustained Arcs].—J. B. Epperson. (*Electronics*, July & Aug. 1939, Vol. 12, Nos. 7 & 8, pp. 30–33 & 31–34.)

4430. A CONCENTRIC CABLE FOR USE AS A SHORT-WAVE ANTENNA FEEDER [Comparison with Copper Tubular Feeder at 10 & 20 Mc/s].—H. Takeuchi & M. Abe. (*Nippon Elec. Comm. Eng.*, May 1939, No. 16, p. 632: summary only.)

4431. A FEW FEEDER CONSIDERATIONS: LOSSES IN TUNED LINES AND ADJUSTMENT OF FLAT LINES.—B. Goodman. (*QST*, Sept. 1939, Vol. 23, No. 9, pp. 48–49 and 114.)

4432. IMPEDANCE MEASUREMENTS ON BROADCAST ANTENNAS [Resonance Methods: Null Methods (including "Double-T" Methods—"will probably be more widely exploited in the future"): Sources of Error: Choice of Method: Coaxial Lines: etc.].—D. B. Sinclair. (*Communications*, June & July, 1939, Vol. 19, Nos. 6 & 7, pp. 5–9 and 26 & 5–9 and 26. .28.)

4433. GENERALISATION OF VECTOR-SCALAR-POTENTIAL AND CONDUCTION CURRENT VIEWED FROM THE STANDPOINT IN THE FARADAY-MAXWELL THEORY.—R. Oo. (*Nippon Elec. Comm. Eng.*, July 1939, No. 17, p. 51: summary only.) *Cf.* Alford, 4047 of 1936.

4434. THE USEFUL RADIATION POWER OF BEAM ANTENNAS [by Integration of Poynting Flux: as Earth Refraction-Factor increases, Useful Radiation increases for Horizontal Beam, decreases for Vertical: Horizontal more Effective in Most Cases: etc.].—T. Kato. (*Nippon Elec. Comm. Eng.*, May 1939, No. 16, pp. 600–603.)

4435. A CATHODE-RAY ANTENNA PHASEMETER.—J. P. Taylor. (*Electronics*, April 1939, Vol. 12, No. 4, pp. 62–63 and 64, 65.) Claimed to be simpler than that dealt with in 3566 of September.

4436. ANTENNA RADIATION CHART [with Discussion of Correction Factors].—L. J. Giacoletto. (*Electronics*, July 1939, Vol. 12, No. 7, pp. 35 and 36.)

4437. A DIRECTIVE PROGRESSIVE-WAVE AERIAL [Wires of Length λ grouped (in One or More Squares) in Horizontal Planes, at 45° to Main Direction of Arrival, and interconnected through Phase Adjusters: for Transmission or Reception], *and* Short-Wave Receiving Aerial Type G.—V. Gori: A. Niutta. (*U.R.S.I. Proc. of* 1938 *Gen. Assembly*, Fasc. 1, Vol. 5, 1938, pp. 331–332: pp. 332–335: both in Italian.)

Gori's paper serves as an introduction to Niutta's, which deals more fully with the same type of array considered only as a receiving aerial. Gori points out that the analysis of the system brings out some interesting properties which could not be foretold, and which will be dealt with in a future paper. Niutta's calculated radiation diagram agrees well with the experimental diagram obtained by aeroplane measurements.

4438. NOTE ON A PARTICULAR CASE OF MULTIPLE DIRECTIVE AERIALS [Calculation of the High Gain of Three Rows of Vertical Dipoles fed with Suitable Phase Differences: Confirmation by Rome/New-York Tests].—V. Gori. (*U.R.S.I. Proc. of* 1938 *Gen. Assembly*, Fasc. 1, Vol. 5, 1938, pp. 328–331: in Italian.)

4439. COMPARISON OF FADING CHARACTERISTICS: TUNED BEAM ANTENNAS *versus* HALF-WAVE DIPOLES [No Special Advantage in Ordinary Tuned Beam System: Measurements with "Wide-Range Logarithmic Compresser" (Cu_2O Rectifier & Valve) and C-R Oscillograph].—M. Nakagami & K. Akazawa. (*Electrot. Journ.*, Tokyo, June 1939, Vol. 3, No. 6, p. 144.)

4440. ON THE ELIMINATION OF ECHO SIGNALS BY MEANS OF A LONG-WIRE ANTENNA.—Nakagami & Miya. (*See* 4388.)

4441. THE DIRECTIONAL AERIAL AT THE MORIOKA BROADCASTING STATION [Two-Spaced T-Type Members].—H. Mitui. (*Nippon Elec. Comm. Eng.*, May 1939, No. 16, p. 634: summary only.)

4442. THE DIRECTIVITY OF AN "INVERTED V" ANTENNA, AND ITS APPLICATIONS [Horizontal-Plane Field Distribution is Ellipse, Lemniscate, or Four-Leaved Rose, according to Length of Inclined Members].—M. Korekoda. (*Nippon Elec. Comm. Eng.*, May 1939, No. 16, pp. 630–631: summary only.)

4443. "ANTENNEN. IHRE THEORIE UND TECHNIK" [Book Review].—H. Brückmann. (*T.F.T.*, July, 1939, Vol. 28, No. 7, pp. 289–290.)

VALVES AND THERMIONICS

4444. ULTRA-SHORT-WAVE OSCILLATORS [particularly the Negative-Grid Type: Limiting Features and Their Interdependence: Double-Lead Triodes (Bell Labs., and S.T. & C. "Micromesh" with Indirectly Heated Cathodes): Operation of "Linear" Oscillator: Multiple Operation].—D. H. Black. (*Elec. Communication*, April 1939, Vol. 17, No. 4, pp. 325–334.) For another paper with practically the same title *see* 2729 of July.

4445. [Ultra-] SHORT-WAVE VALVES [Lecture before International Short-Wave Congress of 1937: including the Modulation of Magnetrons by the Time-Modulation Process].—K. Posthumus. (*Philips Transmitting News*, April 1939, Vol. 6, No. 1, pp. 25–26: summary only.)

4446. THEORY OF ASYMMETRICALLY SPLIT MAGNETRONS [Conditions for "B-Type" Oscillations].—M. Hisida. (*Electrot. Journ.*, Tokyo, June 1939, Vol. 3, No. 6, p. 144.)

4447. SPECIALLY SECTIONALISED MAGNETRON TUBE [Each Segment of 4-Split Anode led out Independently and connected in Pairs to Two Separate External Circuits: Results].—K. Owaki. (*Nippon Elec. Comm. Eng.*, May 1939, No. 16, p. 631: *Rep. of Rad. Res. in Japan*, [dated] Dec. 1938, Vol. 8, No. 3, Abstracts p. 21.)

4448. IMPEDANCE PROPERTIES OF ELECTRON STREAMS [with High Initial Velocities, in Multi-Electrode Valves: Theoretical Conditions for Formation of Negative Input Capacitance & Conductance (even at Frequencies where Transit Angle is Quite Large): Design of Electronic Negative Capacitances: Experimental Confirmation: Occurrence of "Kipps" (Abrupt Changes)].—L. C. Peterson. (*Bell S. Tech. Journ.*, July 1939, Vol. 18, No. 3, pp. 465–481.)

4449. REPRESENTATION OF THE PLANAR MOTION OF ELECTRONS IN MAGNETIC AND ELECTRIC FIELDS BY COMPLEX VECTOR LOCI [deduced from Differential Equations: Three-Body Problem for Forces proportional to Distance].—H. Kleinwächter. (*Arch. f. Elektrot.*, 12th July 1939, Vol. 33, No. 7, pp. 479–486.)

4450. MULTI-PURPOSE MIDGET TUBES.—Arcturus Company. (*Electronics*, June 1939, Vol. 12, No. 6, p. 48.)

4451. THE CHOICE OF TUBES FOR WIDE-BAND AMPLIFIERS.—D. Pollack. (*Electronics*, April 1939, Vol. 12, No. 4, pp. 38 and 42, 44.)

4452. PROPERTIES OF BIASED DIODE RECTIFIERS [as used for A.V.C., "Quiet Tuning," Signal Rectification, etc: Extension of Marique's Work on Unbiased Diodes, and Experimental Confirmation].—F. C. Williams & A. Fairweather. (*Wireless Engineer*, July 1939, Vol. 16, No. 190, pp. 330–339.) For Marique's paper *see* 1391 of 1935.

4453. AMPLIFICATION BY SECONDARY-ELECTRON EMISSION [Survey, including Multipliers using Combined Electrostatic & Magnetic Focusing, and Electrostatic only (Solid Target and Close-Mesh Target Types, including the "Multipactor")].—W. H. Rann. (*Journ. of Scient. Instr.*, Aug. 1939, Vol. 16, No. 8, pp. 241–254.)

4454. THE SECONDARY-EMISSION VALVE IN AN AMPLIFIER [particularly in I.F. Amplifiers for Television].—R. Valecka. (*Funktech. Monatshefte*, July 1939, No. 7, pp. 215–217.)

4455. SECONDARY ELECTRONS AND SECONDARY-ELECTRON MULTIPLIERS [Survey, with 20 Literature References].—O. Peter. (*Funktech. Monatshefte*, June 1939, No. 6, Supp. pp. 41–44.)

4456. SECONDARY ELECTRON EMISSION: PART IV—COMPOUNDS WITH A HIGH CAPACITY FOR SECONDARY ELECTRON EMISSION: PART V—THE MECHANISM OF SECONDARY ELECTRON EMISSION.—H. Bruining & J. H. de Boer. (*Physica*, Aug. 1939, Vol. 6, No. 8, pp. 823–833 & 834–839: in English.) Part IV is a further development of Part I (982 of 1938). Part V follows on directly from Part IV.

4457. REMARKS ON "REPORT ON THE PRESENT STATE OF KNOWLEDGE CONCERNING FLUCTUATION VOLTAGES IN ELECTRICAL NETWORKS AND THERMIONIC TUBES."—E. Spenke: Moullin. (*U.R.S.I. Proc. of* 1938 *Gen. Assembly*, Fasc. 2, Vol. 5, 1938, pp. 41–45: in French.) *See* p. 41, and 2788 of July.

4458. OUTPUT-STAGE DISTORTION: SOME MEASUREMENTS ON DIFFERENT TYPES OF OUTPUT VALVES [Measuring Installation: Results with Modern Triode, Pentode, & Tetrode: Advantages of Modern Pentode with Inverse Feedback].—A. J. H. van der Ven. (*Wireless Engineer*, Aug. & Sept. 1939, Vol. 16, Nos. 191 & 192, pp. 383–390 & 444–452.)

4459. PENTODE AND TETRODE OUTPUT VALVES [and the Obtaining of Good Efficiency with Low Distortion at Low Potentials, by Use of Suppressor Grid and Space Charge].—J. L. H. Jonker. (*Wireless Engineer*, June & July 1939, Vol. 16, Nos. 189 & 190, pp. 274–286 & 344–349.)

4460. AN OSCILLOSCOPE FOR THE DETERMINATION OF CHARACTERISTIC CURVES [of Transmitting Valves].—Tj. Douma & P. Zijlstra. (*Philips Transmitting News*, April 1939, Vol. 6, No. 1, pp. 18–24: in English & German concurrently.) Some improvements to the instrument dealt with in 1476 of April, and discussion of calibration, etc.

4461. COMPENSATOR FOR THE RADIATION METHOD OF MEASURING OSCILLATOR EFFICIENCY [particularly Necessary at Ultra-High Frequencies].—F. P. Cowan. (*Review of Scient. Instr.*, Aug. 1939, Vol. 10, No. 8, pp. 243–244.) For the radiation method *see* 1457 of 1936.

4462. A PRECISION METHOD FOR THE MEASUREMENT OF THE MUTUAL CONDUCTANCE OF THERMIONIC VALVES [with Accuracy within $\pm$ 0.002 mA/V: A.C. Bridge Method using Mutual Inductances].—N. F. Astbury. (*Journ. of Scient. Instr.*, Aug. 1939, Vol. 16, No. 8, pp. 269–272.)

4463. A METHOD OF MEASURING VACUUM-TUBE COEFFICIENTS [with Elimination of Unbalancing Effects of Inter-Electrode and Wiring Capacities].—H. S. Polk. (*Electronics*, July 1939, Vol. 12, No. 7, p. 38.)

4464. AN IMPULSE MEASURING SET [measuring Crest Amplitude and Decay to Specified Level: primarily for Measurement of Valve Microphonicity].—A. S. Grant & D. H. Macnee. (*Journ. of Scient. Instr.*, Sept. 1939, Vol. 16, No. 9, pp. 290–297.)

4465. MANUFACTURE OF VALVES BY MACHINERY.—T. B. Hall & A. H. Howe. (*Journ. of Scient. Instr.*, Sept. 1939, Vol. 16, No. 9, pp. 277–285.) From the M.O. Valve Company.

4466. AUTARCHY IN THE THERMIONIC VALVE INDUSTRY.—(*Radio e Televisione*, July 1939, Vol. 4, No. 1, pp. 1–12.)

4467. THE INDUSTRIAL PRODUCTION AND UTILISATION OF KRYPTON.—(*Génie Civil*, 2nd Sept. 1939, Vol. 115, No. 10, pp. 198–200.) *See* also 162 of January (Klemperer).

4468. TRANSMITTING VALVES WITH FORCED AIR-COOLING [PA 12/15 Pentode modified for This instead of Usual Water-Jacket: Two in Push-Pull give 6 kW at 6 m Wavelength, Anode Efficiency 50%].—M. van de Beek. (*Philips Transmitting News*, April 1939, Vol. 6, No. 1, pp. 3–14: in English & German concurrently.) For the PA 12/15 pentode *see* 3321 of 1937.

4469. 200 KW VALVES WITH REPLACEABLE FILAMENTS [for the Schenectady Short-Wave 100 kW Transmitter: Continuously Evacuated, with Activated Tungsten Filaments: Anode Voltage about 8000 V].—(*Gen. Elec. Review*, Aug. 1939, Vol. 42, No. 8, p. 369.)

4470. NEW TUBES [RCA Battery-Operated Diode-Triode Power-Amplifier Pentode (1D8GT), Arcturus Beam-Power-Amplifier with Centre-Point Filament Connection (3Q5GT) and Arcturus Combined Power-Amplifier & Half-Wave Rectifier (70A7GT)].—(*Electronics*, Aug. 1939, Vol. 12, No. 8, pp. 63 and 64.)

4471. "THEORY AND APPLICATION OF ELECTRON TUBES" [Book Review].—H. J. Reich. (*Wireless Engineer*, June 1939, Vol. 16, No. 189, p. 286.)

4472. CONVECTION AND CONDUCTION OF HEAT IN GASES [Detailed Investigation of Diameter of "Langmuir Film" around Warm Filaments in Gases].—I. Brody & F. Körösy. (*Journ. of Applied Phys.*, Aug. 1939, Vol. 10, No. 8, pp. 584–596: abstract only in *Phys. Review*, 15th July 1939, Series 2, Vol. 56, No. 2, p. 217.)

4473. ON THE SURFACE STATES ASSOCIATED WITH A PERIODIC POTENTIAL, *and* USE OF SURFACE STATES TO EXPLAIN ACTIVATED ADSORPTION [Theory].—W. Shockley: W. G. Pollard. (*Phys. Review*, 15th Aug. 1939, Series 2, Vol. 56, No. 4, pp. 317–323: pp. 324–336.)

4474. TEMPERATURE DEPENDENCE OF THE WORK FUNCTION OF TUNGSTEN [Measurements using Kelvin Method for Contact Potential between Two Filaments: Measured Increase of Work Function with Temperature: Effect of Variations in Contamination].—J. G. Potter. (*Phys. Review*, 15th July 1939, Series 2, Vol. 56, No. 2, p. 216: abstract only.)

DIRECTIONAL WIRELESS

4475. U- AND H- ADCOCK RADIO DIRECTION-FINDING INSTALLATIONS FOR AVIATION.—O. Heer. (*Zeitschr. V.D.I.*, 29th July 1939, Vol. 83, No. 30, pp. 878–880.)

4476. THE LORENZ ALPINE RADIO BEACON FOR AIRCRAFT.—(*Lorenz Berichte*, June 1939, No. 1/2, pp. 64–66.)

4477. NEW FOUR-BEAM BLIND-LANDING SYSTEM [giving Buzz on Guide Path, "Right", "Left", "Up", & "Down" when off Path].—C. W. Hansell. (*Sci. News Letter*, 19th Aug. 1939, Vol. 36, No. 8, p. 116.)

4478. DIRECTION FINDING: IMPROVEMENT IN THE QUALITY OF OBSERVATIONS BY THE USE OF NON-LINEAR AMPLIFIERS [or Indicating Meters: Investigation of Patent Claims: Confusion as to Precise Concept of "Sharpness" of Bearing: Improvement of Flat Minima by Increasing Amplification with Increasing Input].—W. Ross & R. E. Burgess. (*Wireless Engineer*, Aug. 1939, Vol. 16, No. 191, pp. 399–401.)

4479. CORRECTION TO CURVES IN "GROUND AND IONOSPHERIC WAVES."—W. Ross. (*Wireless Engineer*, July 1939, Vol. 16, No. 190, pp. 349–350.)

4480. REPORT OF SUB-COMMISSION 4: DIRECTION-FINDING ON ATMOSPHERICS.—Watson Watt. (*See* 4317.)

4481. PHILIPS MARINE BEACON TRANSMITTER BRA 070/7 [Omnidirectional, with Self-Radiating Mast].—(*Philips Transmitting News*, April 1939, Vol. 6, No. 1, pp. 15–17; in English & German concurrently.)

4482. YACHT D.F. SET: LONG-WAVE RECEIVER FOR WEATHER FORECASTS AND POSITION FINDING.—F. L. Devereux. (*Wireless World*, 24th Aug. 1939, Vol. 45, pp. 164–167.)

4483. WHALING AND WIRELESS [Novel Use of Direction Finding: Description of Gear].—(*Wireless World*, 28th Sept. 1939, Vol. 45, pp. 301–302.) *See* also 2626 of June.

ACOUSTICS AND AUDIO-FREQUENCIES

4484. DIRECT OBSERVATION OF DIRECTIVITY CURVE [*e.g.* of a Magnetostrictive Sound Generator] ON A BRAUN TUBE [with Magnetic Field rotated at Same Speed as Apparatus under Test: applicable also "in Optical or Wireless Measurement, and also as a Direction Finder"].—S. Morita & Y. Sitizyo. (*Electrot. Journ.*, Tokyo, Aug. 1939, Vol. 3, No. 8, p. 191.) For another c-r tube arrangement *see* 4519, below.

4485. CONE SOUND PROJECTOR USING OUTPUT OF BOTH SIDES OF CONE DIAPHRAGM.—University Laboratories, New York. (*Electronics*, Aug. 1939, Vol. 12, No. 8, p. 66.)

4486. "SPATIAL EXPANDER" [Loudspeaker & Cabinet (with "Breather Cells" to eliminate Back Pressure) overcoming Directional Effect at High Frequencies].—M. Weil: Audak Company. (*Electronics*, March 1939, Vol. 12, No. 3, pp. 68..72.)

4487. ON THE BUILDING-IN OF LOUDSPEAKERS [with Formulae and Test Results on a "Cinaudagraph" Loudspeaker].—W. Furrer. (*Bull. Assoc. suisse des Élec.*, No. 14, Vol. 30, 1939, pp. 369–372.)

4488. PIEZOELECTRICITY OF POTASSIUM PHOSPHATE [Static Measurement of Piezo-Modulus as Function of Temperature: Rapid Increase in Neighbourhood of Curie Point of Rochelle Salt].—W. Lüdy. (*Zeitschr. f. Physik*, No. 5/6, Vol. 113, 1939, pp. 302–305.)

4489. THE REPRESENTATION OF ELECTRO-MECHANICAL APPARATUS [Loudspeakers, Pick-Ups] BY ELECTRICAL EQUIVALENT-CIRCUIT DIAGRAMS.—J. G. Lang. (*Funktech. Monatshefte*, June 1939, No. 6, pp. 183–189.)

4490. PICK-UP DEVICES, *and* PIEZOELECTRIC PICK-UPS.—A. Pinciroli: G. Boselli. (*Boll. del Centro Volpi di Elett.*, English Edition, July/Sept. 1938, Year 1, No. 3, p. 97d: p. 97d.)

4491. A CONTRIBUTION TO THE THEORY OF THE GRAMOPHONE DISC RECORD: THE PICK-UP PROCESS [and the Superiority of Vertical ("Hill & Dale") over Lateral Recording].—R. Bierl. (*Akust. Zeitschr.*, July 1939, Vol. 4, No. 4, pp. 238–252.)

4492. RECORDER CHARACTERISTICS [Table of American Gramophone-Disc Recorders].—M. Apstein. (*Communications*, April 1939, Vol. 19, No. 4, p. 14.)

4493. TALKING BOOKS [for the Blind: New Bill regarding Contracts].—(*Electronics*, July 1939, Vol. 12, No. 7, p. 9.)

4494. TAPE RECORDER [using Paper or Cellophane Tape giving Permanent Filable Sound Records at about One Dollar per Hour: Electrochemical Action].—M. Dustin. (*Electronics*, March 1939, Vol. 12, No. 3, p. 75.)

4495. THE VARIOUS TECHNIQUES FOR THE RECORDING OF SOUND, AND THEIR APPLICATIONS IN BROADCASTING [Comparison of Disc and Film Methods, including the German "Magnetophone" Film System].—M. Adam. (*Rev. Gén. de l'Élec.*, 19th Aug. 1939, Vol. 46, No. 7, pp. 195–200.)

4496. SOUND RECORDING IN STUDIOS AND THEATRES [and the Correct Placing of the Microphones], *and* THE TECHNIQUE FOR FAITHFUL RECORDING AND REPRODUCING OF SOUND PICTURES.——C. Tutino: F. Massarelli. (*Boll. del Centro Volpi di Elett.*, English Edition, July/Sept. 1938, Year 1, No. 3, p. 105d.: p. 107d.)

4497. ANALYSIS AND MEASUREMENT OF DISTORTION IN VARIABLE-DENSITY RECORDING, *and* SOUND PICTURE RECORDING AND REPRODUCING CHARACTERISTICS.—Frayne & Scoville : Loye & Morgan. (*Bell S. Tech. Journ.*, July 1939, Vol. 18, No. 3, p. 540 : p. 542 : summaries only.)

4498. ARC REFLECTORS AS A SOURCE OF DISTURBING SOUNDS IN STUDIOS : CAUSES AND REMEDIES.—R. Müller. (*Boll. del Centro Volpi di Elett.*, English Edition, July/Sept. 1938, Year 1, No. 3, p. 109d.)

4499. THE POLYRHETOR [Rotating-Drum Sound-on-Film System acting as Synchronised "Guide" to Visitors in Endless "Carry-Go-Round" at General Motors' Exhibit at New York World's Fair].—G. T. Stanton. (*Communications*, July 1939, Vol. 19, No. 7, pp. 10–11 and 29.)

4500. SOUND-EFFECTS CONSOLE.—W. W. Strathy. (*Communications*, July 1939, Vol. 19, No. 7, pp. 12–14.)

4501. ON THE SPHERICAL VELOCITY MICROPHONE [for Submarine Signalling].—M. Matudaira & T. Isii. (*Nippon Elec. Comm. Eng.*, July 1939, No. 17, p. 52 : short summary only.)

4502. ON THE CLAMPED CIRCULAR PLATE [used as Element in Electro-Acoustic Transformer].—T. Hayasaka. (*Nippon Elec. Comm. Eng.*, July 1939, No. 17, pp. 52–53 : summary only.) Continuing the work referred to in 3987 of 1938.

4503. TRANSVERSE VIBRATION OF BAR [Uniform Bar used in Mechanical Filters & Other Electro-Acoustic Instruments].—T. Hayasaka. (*Nippon Elec. Comm. Eng.*, July 1939, No. 17, p. 53 : short summary only.)

4504. SIMPLIFIED CALCULATIONS ON MULTI-WINDING TRANSFORMERS [*e.g.* Output Transformer for feeding 3 Loudspeakers].—G. H. Browning. (*Electronics*, May 1939, Vol. 12, No. 5, pp. 46–50.)

4505. OUTPUT-STAGE DISTORTION.—van der Ven. (*See* 4458.)

4506. ELECTRONIC TUBES FOR ELECTROACOUSTICAL AMPLIFIERS [Required Characteristics for Different Stages : Suitable Valves].—C. Pozzi. (*Boll. del Centro Volpi di Elett.*, English Edition, July/Sept. 1938, Year 1, No. 3, p. 111d.)

4507. A COMPACT REMOTE AMPLIFIER.—R. S. Duncan. (*Electronics*, July 1939, Vol. 12, No. 7, pp. 28–29.)

4508. A RESISTANCE-COUPLED HIGH-FIDELITY AMPLIFIER [20–20 000 c/s within 1 db, with Compression & Expansion and Other Refinements].—Amplifier Company. (*Electronics*, June 1939, Vol. 12, No. 6, p. 76.)

4509. ELECTROACOUSTICAL DIFFUSION OF SOUNDS, *and* PROPAGATION PHENOMENA IN PUBLIC ADDRESS INSTALLATIONS.—G. Fioravanti : G. Maione. (*Boll. del Centro Volpi di Elett.*, English Edition, July/Sept. 1938, Year 1, No. 3, p. 109d : p. 111d.)

4510. PUBLIC ADDRESS SYSTEM AT THE THIRTY-FOURTH INTERNATIONAL EUCHARISTIC CONGRESS, BUDAPEST, 1938.—de Czeglédy. (*Elec. Communication*, April 1939, Vol. 17, No. 4, pp. 319–324.)

4511. ELECTROACOUSTIC INSTALLATION OF THE SAARPFALZ THEATRE, SAARBRÜCKEN.—(*Radio e Televisione*, July 1939, Vol. 4, No. 1, pp. 26–31.)

4512. LAGOON OF NATIONS SOUND SYSTEM [at New York World's Fair].—(*Electronics*, July 1939, Vol. 12, No. 7, pp. 26–27.)

4513. A SINGLE-TUBE INTERCOMMUNICATOR [using the Type 32L7 Beam-Power Output Valve & Half-Wave Rectifier].—G. P. Deitz. (*Electronics*, June 1939, Vol. 12, No. 6, pp. 58 and 60.)

4514. THE MARCONI-E.M.I. AUDIO-FREQUENCY EQUIPMENT AT THE LONDON TELEVISION STATION.—I. L. Turnbull & H. A. M. Clark. (*Journ. I.E.E.*, Sept. 1939, Vol. 85, No. 513, pp. 439–462 : Discussion pp. 462–467.)

4515. TELEPHONY AND TELEVISION BY COAXIAL CABLES.—van Mierlo. (*See* 4545.)

4516. ARCHITECTURAL ACOUSTICS AT THE VATICAN CITY.—T. De Micheli. (*Boll. del Centro Volpi di Elett.*, English Edition, July/Sept. 1938, Year 1, No. 3, p. 107d.)

4517. THE FIRST ATHENIAN STUDIO OF THE NEW GREEK BROADCASTING SERVICE.—G. Schadwinkel. (*Telefunken-Hausmitteilungen*, July 1939, Vol. 20, No. 81, pp. 97–99.) For the Athens 15 kw broadcasting station see *ibid.*, pp. 120–121.

4518. ACOUSTIC PROPERTIES OF MATERIALS AND THEIR MEASUREMENT.—A. Gigli. (*Boll. del Centro Volpi di Elett.*, English Edition, July/Sept. 1938, Year 1, No. 3, p. 101d.)

4519. BRAUN TUBE METHOD OF REVERBERATION MEASUREMENT [Direct Representation of Building-Up & Decay Processes gives only a Low Space Factor : Rotating-Commutator Arrangement for Improved Results (Exponential Time Axis, etc.)].—S. Morita. (*Electrot Journ.*, Tokyo, Aug. 1939, Vol. 3, No. 8, pp. 190–191.) For another c-r tube arrangement *see* 4484, above.

4520. METHODS OF RHYTHMIC INTERRUPTIONS FOR REVERBERATION MEASUREMENTS [New Method].—A. Sellerio & Del Bosco. (*Boll. del Centro Volpi di Elett.*, English Edition, July/Sept. 1938, Year 1, No. 3, p. 105d.)

4521. AN IMPULSE MEASURING SET [measuring Crest Amplitude and Decay to Specified Level].—Grant & Macnee. (*See* 4464.)

4522. A New Apparatus for the Direct Reading of the Pitch and Intensity of Sound, and Its Application [and a Comparison with the Grützmacher-Lottermoser Procedure].—J. Obata & R. Kobayashi. (*Electrot. Journ.*, Tokyo, July 1939, Vol. 3, No. 7, pp. 152–156.) The apparatus was described briefly in the paper dealt with in 1551 of April.

4523. Construction and Properties of an Adjustable Acoustic Reference Impedance [for Measurements by the "Bridge" Method, illustrated by Absorption Curves of a Conical Horn and of an Acoustic Low-Pass Filter].—K. Schuster & W. Stöhr. (*Akust. Zeitschr.*, July 1939, Vol. 4, No. 4, pp. 253–260.) For the "bridge" method *see*, for example, 2196 of 1937 (Robinson).

4524. Bridge for the Direct Measurement of Impedances [primarily for the Rapid Measurement, on the Work-Bench, of Matching Transformers for Loudspeakers: Bad Reproduction frequently Result of Mis-Matching, often due to Strange Impedance Values given by Manufacturers of Pick-Ups, etc., or to Use of Pentodes].—L. Chrétien. (*L'Onde Élec.*, July 1939, Vol. 18, No. 211, pp. 320–326.)

4525. A Method of Measuring Transductors [in Sound-Ranging Equipment: Delay measured by Use of a Frequency modulated by a Very Low Second Frequency].—M. Federici. (*Boll. del Centro Volpi di Elett.*, English Edition, July/Sept. 1938, Year 1, No. 3, p. 119d.)

4526. A Modern Audiometer [particularly for Deafness Tests].—C. J. Penther. (*Electronics*, Aug. 1939, Vol. 12, No. 8, pp. 38 . . 42.)

4527. The Analysis and Measurement of Noise in Engineering Problems: with Special Reference to Electrical Machinery.—B. B. Ray. (*Sci. & Culture*, Calcutta, July 1939, Vol. 5, No. 1, pp. 17–25.)

4528. Sound Measurements in Industry [General Account].—E. J. Abbott. (*Journ. of Applied Phys.*, Aug. 1939, Vol. 10, No. 8, pp. 526–531.)

4529. VU-DB Relationships [Chart showing Relation between New "Volume Unit" and Decibel Scales].—F. B. Hales: Affel. (*Electronics*, May 1939, Vol. 12, No. 5, p. 36.) *Cf.* Affel, Chinn, & Morris, 1957 of May. For Affel's criticisms *see* July issue, No. 7, p. 9.

4530. Linear Decibel Meter using Cuprous Oxide [No Valves, Very Simple, with Wide (more than 60 db) Range of Measurement].—K. Akazawa & H. Uno. (*Electrot. Journ.*, Tokyo, May 1939, Vol. 3, No. 5, p. 119.)

4531. "Applied Acoustics: Second Edition" [Book Review].—Olson & Massa. (*Wireless Engineer*, July 1939, Vol. 16, No. 190, p. 305.)

4532. Periodic Variation of Temperature caused by Sound Wave [Theory and Experimental Confirmation].—T. Hayashi. (*Electrot. Journ.*, Tokyo, May 1939, Vol. 3, No. 5, pp. 103–106.)

4533. Measurement of Sound Intensity under Water by the Resonance Disc.—T. Hayashi. (*Electrot. Journ.*, Tokyo, Aug. 1939, Vol. 3, No. 8, pp. 175–178.)

4534. On a Symmetrical Vibrating Shell [for Submarine Vibrometers, etc.].—T. Hayasaka. (*Nippon Elec. Comm. Eng.*, July 1939, No. 17, pp. 49–50: summary only.)

4535. The "Striae Method" [Schlierenmethode] applied to the Study of Ultrasonic Fields in Liquids, *and* Physiological Effects of Ultra-Sounds.—C. L. Mendel: M. Ponzio. (*Boll. del Centro Volpi di Elett.*, English Edition, July/Sept. 1938, Year 1, No. 3, p. 115d: p. 115d.)

4536. Utilisation of Ultra-Sounds [in Metallurgy, Chemistry, Marine Services, etc.].—G. Oggioni. (*Boll. del Centro Volpi di Elett.*, English Edition, July/Sept. 1938, Year 1, No. 3, p. 117d.)

4537. Subaqueous Magnetostrictive Echometer [with Stroboscopic Dial Reception].—R. Rago. (*Boll. del Centro Volpi di Elett.*, English Edition, July/Sept. 1938, Year 1, No. 3, p. 117d.)

4538. Ultra-Sound Generators, *and* Transmission and Reception of Ultrasonic Waves by means of Nickel-Alloy Laminated Cores.—A. Ciaccia: M. Federici. (*Boll. del Centro Volpi di Elett.*, English Edition, July/Sept. 1938, Year 1, No. 3, p. 113d: p. 113d.)

4539. Subaqueous Acoustic Signalling [Survey, leading to the "Sword-Shaped" Instrument embodying Recent Improvements].—S. Rosani. (*Boll. del Centro Volpi di Elett.*, English Edition, July/Sept. 1938, Year 1, No. 3, p. 121d.)

4540. Audible-Frequency and Supersonic-Frequency Investigations of Concrete Beams with Flaws.—E. Meyer & E. Bock. (*Akust. Zeitschr.*, July 1939, Vol. 4, No. 4, pp. 231–237.) Further development of the work dealt with in 2857 of 1938.

4541. Water Purification [and Softening] by Supersonic Waves.—Beuthe & others. (*Akust. Zeitschr.*, July 1939, Vol. 4, No. 4, pp. 209–214.)

4542. Precision Measurements of Supersonic-Wave Velocity in Various Liquids, and Their Significance for the Question of Sound Dispersion and for the Technique of Supersonic-Velocity Measurement [Unexpected Importance of Temperature Effect and of Distortion of Wave Front].—E. Schreuer. (*Akust. Zeitschr.*, July 1939, Vol. 4, No. 4, pp. 215–230.)

4543. Theories of the Diffraction of Light at Supersonic Waves.—N. S. Nagendra Nath. (*Akust. Zeitschr.*, July 1939, Vol. 4, No. 4, pp. 263–272: to be contd.)

PHOTOTELEGRAPHY AND TELEVISION

4544. On the Question of the Use of Waves in Tubes as Transmission Channels.—Schriever. (*See* 4276.)

4545. Telephony and Television by Coaxial Cables [Theory, Types of Cable, Repeaters, Terminal Equipment: Determination of Economic Dimensions: Bibliography].—S. van Mierlo. (*Rev. Gén. de l'Élec.*, 8th & 15th July 1939, Vol. 46, Nos. 1 & 2, pp. 7–17 & 39–44.) From the L.M.T. laboratories.

4546. The Transmission of Wide Frequency-Bands over Cable [in Television, Wire Broadcasting, etc: Survey: 1939 Berlin Exhibition Lecture].—A. Agricola. (*Zeitschr. V.D.I.*, 29th July 1939, Vol. 83, No. 30, pp. 869–877.)

4547. Remarks on Single-Sideband Working in Television.—R. Urtel. (*Telefunken-Hausmitteilungen*, July 1939, Vol. 20, No. 81, pp. 80–83.)

Author's summary:—For television transmission with reduced band-width the only possibility is a mixed single-sided double-sided system; *i.e.*, the carrier must lie in the middle of the cutting-off flank of the filter or transmission channel [owing to the great difference between television and sound transmission, that the former is acutely sensitive to phase distortion and only to a subordinate degree to non-linear distortion: moreover, the modulation system adopted in Germany, in which "black" corresponds to a 30% residual carrier, "greatly decreases the danger of non-linear distortion in single-sideband working"]. The requirements of the amplitude and phase curves of the transmission channel in this case are discussed. The building-up processes occurring, as a result of the fulfilment of these conditions, in the transmission of a rectangular pulse are calculated, and the influence of the relation between the width of the curve-flank and the band-width is discussed [Fig. 110 onwards, where p is the ratio of the interval between the carrier and the highest frequency ($\Delta\omega$ in Fig. 109) to the width of the half-flank of the filter ($\delta\omega$ in Fig. 109)].

4548. A Television Film Scanner [in which Film passes downward before Scanning Lens while Electronic Scanning Beam moves upward at Same Speed: 60 Stationary Frames per Sec. from Film photographed at 24 Frames per Sec: Further Advantages].—P. Goldmark: Columbia Broadcasting System. (*Journ. of Applied Phys.*, Aug. 1939, Vol. 10, No. 8, p. 563: short note only.)

4549. Sound Motion Picture Films in Television.—J. A. Maurer. (*Communications*, May/July 1939, Vol. 19, Nos. 5/7, pp. 28 and 30. 32: 17 and 27, 30: & 23–24: to be contd.)

4550. Comparison of Television with the Cinema: Relative Definition.—F. Grisley. (*Wireless World*, 24th Aug. 1939, Vol. 45, p. 183.)

4551. The Marconi-E.M.I. Audio-Frequency Equipment at the London Television Station.—I. L. Turnbull & H. A. M. Clark. (*Journ. I.E.E.*, Sept. 1939, Vol. 85, No. 513, pp. 439–462: Discussion pp. 462–467.)

4552. The Technical Equipment of Television Studios [Survey, with Literature References].—(*Funktech. Monatshefte*, July 1939, No. 7, Supp. pp. 49–52.)

4553. Travelling Television Exhibition of the German Post Office in South America.—(*T.F.T.*, July 1939, Vol. 28, No. 7, p. 288.)

4554. The Technique of Television-Telephony Apparatus ["Two-Way Television": Development from the 1927 Washington/New-York Demonstration to Present Time, including a Simplified Installation with only One C-R Tube for Transmission & Reception].—F. Schröter. (*Telefunken-Hausmitteilungen*, July 1939, Vol. 20, No. 81, pp. 30–50.)

4555. Recent Progress in Television.—H. L. Kirke. (*Journ. Roy. Soc. of Arts*, 3rd Feb. 1939, Vol. 87, pp. 302–327.)

4556. Television [Survey of the Preparatory Work for the German Service].—A. Gehrts. (*Zeitschr. V.D.I.*, 29th July 1939, Vol. 83, No. 30, pp. 881–884.)

4557. The Eiffel Tower Television Transmitter [including Measurements of Distortion, Operation of "Constant Modulation Depth" Regulator (Floating Carrier System), etc.].—S. Mallein & G. Rabuteau. (*Elec. Communication*, April 1939, Vol. 17, No. 4, pp. 382–297: *Rev. Gén. de l'Élec.*, 9th Sept. 1939, Vol. 46, No. 10, pp. 291–305.)

4558. The Fundamentals of Television Engineering.—F. A. Everest. (*Communications*, April/July 1939, Vol. 19, Nos. 4/7, pp. 17–19 and 34, 35: etc.)

4559. Television Economics: Parts IV/VI.—A. N. Goldsmith. (*Communications*, May/July 1939, Vol. 19, Nos. 5/7, pp. 20. 25 and 38: etc.) For previous parts *see* 2844 of July.

4560. Miniature Staging: the Technical Side of Video Effects [including the Employment of the "Psychological Tie"].—W. C. Eddy. (*Communications*, April 1939, Vol. 19, No. 4, pp. 22–23 and 33, 34.)

4561. Television Lighting: Part I.—W. C. Eddy. (*Communications*, May 1939, Vol. 19, No. 5, pp. 17–19: to be contd.)

4562. Television Terminology [Italian, French, English, & German Equivalents].—(*Radio e Televisione*, July 1939, Vol. 4, No. 1, pp. 47–51.) Continued from 2852 of July.

4563. Sight and Sound: Some Close Relationships between Sound Reproduction and Television [including the Need for New Terminology].—"Cathode-Ray." (*Wireless World*, 21st Sept. 1939, Vol. 45, pp. 281–282.)

4564. Television Progress: Report of the Olympia Convention.—(*Wireless World*, 14th Sept. 1939, Vol. 45, pp. 255–256.)

4565. Television—an Old Dream of Mankind! [Introductory Article to Issue chiefly devoted to Television].—H. Rukop. (*Telefunken-Hausmitteilungen*, July 1939, Vol. 20, No. 81, pp. 5–8.)

4566. The Image-Converter Storage-Type Pick-Up Tube [distinguished from the Less Sensitive Storage-Type Pick-Up by the Use of Secondary-Emission Amplification at the Mosaic Surface].—H. Knoblauch & G. W. Kluge. (*Telefunken-Hausmitteilungen*, July 1939, Vol. 20, No. 81, pp. 51–54.)

4567. The Orthicon [Improved ("Gamma Unity") Form of Iconoscope using Low-Velocity Electrons for Scanning].—A. Rose & H. Iams. (*Electronics*, July 1939, Vol. 12, No. 7, pp. 11–14 and 58, 59.) *See* also 3636 of September.

4568. Amplification by Secondary-Electron Emission.—Rann. (*See* 4453.)

4569. The Secondary-Emission Valve in an Amplifier.—Valecka. (*See* 4454.)

4570. Cathode-Ray Image-Transmission Tubes [Telefunken Technique, etc.].—M. Knoll. (*Telefunken-Hausmitteilungen*, July 1939, Vol. 20, No. 81, pp. 65–79.)

1—The production of a small-diameter spot: table of curves showing increase of spot diameter for a cone-shaped ray due to electrostatic repulsion, as a function of aperture, voltage velocity, and ray current. 2—The measurement of electron-optical fields by the electrolytic trough (accuracy within 1% to 1‰) and (for magnetic fields) the exploring-coil apparatus (Figs. 68 & 69). 3—Design of magnetic electron-lenses: refracting-power curve of a lens with and without an iron shell: curve table for focal length of short iron-free lenses, as function of lens-diameter and ampere-turns: description of a permanent-magnet lens and a split (demountable) electro-magnetic lens. 4—Design of electric electron-lenses and immersion-lens systems: formula for focal length of a two-pole equi-diameter lens: simple three-pole immersion system, etc. 5—Design of deflecting systems, including bent elliptical deflecting coils and comparison of their astigmatic error with that of the usual parallel-conductor coil. 6—The charging-up of insulating surfaces by electrons. 7—Raster correction (pin-cushion error, etc.) by compensation coils. 8—Types of tube (including a 100-element switching tube for the Karolus large-picture panel).

4571. Contrast in Kinescopes.—R. R. Law. (*Proc. Inst. Rad. Eng.*, Aug. 1939, Vol. 27, No. 8, pp. 511–524.) A summary was dealt with in 3691 of 1938.

4572. On the Development of the Cathode-Ray Fluorescent Screen [Survey: Ideal Requirements and the Partial Solutions hitherto obtained, Satisfactory as regards Life, Colour, Luminous Output: Unsatisfactory as regards Building-Up & Decay Processes (except for Receiver Tubes): "Fluorescent-Spot" Scanning so far only possible with Help of Electrical Compensation Methods].—A. Schleede & B. Bartels. (*Telefunken-Hausmitteilungen*, July 1939, Vol. 20, No. 81, pp. 100–108.)

4573. Fluorescent Materials for Television Tubes [and the Mixing of Colours].—G. T. Schmidling. (*Communications*, April 1939, Vol. 19, No. 4, pp. 30 and 31, 32.) For previous work *see* 676 of 1937.

4574. Photoconductivity of Crystalline Willemite at Low Temperatures.—R. Hofstadter & R. C. Herman. (*Phys. Review*, 15th July 1939, Series 2, Vol. 56, No. 2, p. 212: abstract only.)

4575. Scanning Coil Construction.—P. D. Tyers. (*Wireless World*, 14th & 21st Sept. 1939, Vol. 45, pp. 248–250 & 279–280.)

4576. The Historical Development of the Interlaced Scanning Method: II—The First Applications of the Cathode-Ray Tube in Interlaced Scanning: III—Interlaced Scanning of Sound Films.—F. Raeck. (*Funktech. Monatshefte*, June & July 1939, Nos. 6 & 7, Supp. pp. 45–46 & 53–56.) Continued from 3233 of August.

4577. Synchronising-Signal Generator [supplying Synchronising, Scanning, & Blanking Waves].—DuMont Laboratories. (*Proc. Inst. Rad. Eng.*, Aug. 1939, Vol. 27, No. 8, pp. ii and iv.) "Can be installed and operated by untrained personnel."

4578. Generation of the Synchronising Signals for Television [Flexible Arrangement for Various Typical Signal Wave Forms, with Ratio of High & Low Scanning Frequencies established by Frequency Step-Down by Forced Synchronisation].—A. Osawa. (*Nippon Elec. Comm. Eng.*, May 1939, No. 16, pp. 631–632: summary only.)

4579. Synchronising Impulse Generator for Television Deflecting Circuits.—G. Zaharis. (*Electronics*, June 1939, Vol. 12, No. 6, pp. 48 and 54..58.) Based on Potter's circuit (3684 of 1938).

4580. A New Hard-Valve Relaxation Oscillator.—D. H. Black. (*Elec. Communication*, July 1939, Vol. 18, No. 1, pp. 50–56.) A summary was dealt with in 2000 of May.

4581. An Operational Treatment of the Design of Electro-Magnetic Time-Base Amplifiers [instead of the usual Fourier-Analysis Treatment leading to Results only Interpretable with Great Labour].—L. Jofeh. (*Journ. I.E.E.*, Sept. 1939, Vol. 85, No. 513, pp. 400–408.)

4582. Clarification of Symbols in "The Input Impedance of Self-Biased Amplifiers."—F. C. Williams. (*Wireless Engineer*, July 1939, Vol. 16, No. 190, p. 350.) *See* 2860 of July.

4583. Corrections to "Amplifier Testing by means of Square Waves."—G. Swift. (*Communications*, July 1939, Vol. 19, No. 7, p. 24.) *See* 2023 of May.

4584. On the Relation between the Transmission of Light and the Conduction of Electricity in Thin Metallic Films [as in Photoelectric Cells, etc: Experimental Investigation and Analysis of Results: Abnormal Properties explained by Grain Construction: Practical Conclusions].—Y. Saito. (*Electrot. Journ.*, Tokyo, Aug. 1939, Vol. 3, No. 8, pp. 180–185.)

4585. Electron Conduction in Crystals [Report on Recent Results at High Temperatures with Mixed Conduction of Ions and Electrons: How Secondary Photoelectric Currents Arise: Rectification in Semiconductors: Grid Control of Electron-Currents in Crystals].—R. Hilsch. (*Naturwiss.*, 21st July 1939, Vol. 27, No. 29, pp. 489–492.)

4586. The Photoelectric Effect and the Action of "Normal" Waves: Probability and Entropy [Quantum Theory and Theories of Photoelectric Effect and Compton Effect explained without Intervention of Photons: etc.].—J. Loiseau. (*Rev. Gén. de l'Élec.*, 22nd July 1939, Vol. 46, No. 3, pp. 87–94.)

4587. Magnetic Field Effect upon the Photoelectric Properties of Iron [Effect in Direction of Increase of Work Function found near Long-Wave Limit].—N. K. Olson. (*Phys. Review*, 15th July 1939, Series 2, Vol. 56, No. 2, p. 210: abstract only.) Continuation of work referred to in 4491 of 1938.

4588. The Selenium Photoelement: III—Behaviour in the H.F. Circuit [Beat Oscillator Method of Investigation: Equivalent Circuit: Mechanism similar to that of Zinc-Sulphide Phosphors: Phenomena explained as Variations of Resistance and Capacity of Basic Material of Semiconductor: Behaviour in H.F. Circuit and Dielectric Constant of Semiconductor deduced from Vector Diagrams].—F. Goos. (*Zeitschr. f. Physik*, No. 5/6, Vol. 113, 1939, pp. 334–349.) For the writer's work on zinc-sulphide phosphors *see* 1148 of March.

4589. The Optical Transparency of Selenium in Connection with the Photoelectric Conduction [Photoelectric Properties of Grey Selenium depend on Enclosed Traces of Red Selenium].—G. Mönch. (*Physik. Zeitschr.*, 15th July 1939, Vol. 40, No. 14, pp. 487–488.)

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4591. The Supersonic Light Control and Its Application to Television, with Special Reference to the Scophony Television Receiver.—D. M. Robinson. (*Proc. Inst. Rad. Eng.*, Aug. 1939, Vol. 27, No. 8, pp. 483–486.)

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4594. On Community Reception in Television [Preliminary Considerations, and an Experimental Installation in which the Sound Signals are supplied at A.F., and the Picture Signals modulated on an I.F. of 4.2 Mc/s, to the Cable Network: Individual Receivers consist only of C-R Tube (with Scanning Device) and Loudspeaker: Possibility of Inclusion of Ordinary Sound Broadcasting].—H. O. Roosenstein. (*Telefunken-Hausmitteilungen*, July 1939, Vol. 20, No. 81, pp. 25–29.)

4595. Simplifying Television Controls ["Does the 'Contrast' Knob always Do What It Says?"].—"Cathode-Ray." (*Wireless World*, 24th Aug. 1939, Vol. 45, pp. 189–190.)

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4597. H.T. Transformer Construction: Safeguards against Breakdown [in Television Receivers, etc.].—N. Partridge. (*Wireless World*, 24th Aug. 1939, Vol. 45, pp. 168–170.)

4598. Standard Television [the Example of the German "Unit" Receiver].—(*Wireless World*, 17th Aug. 1939, Vol. 45, p. 160.)

4599. The German "Unit" Television Receiver [and the Novelties contained in It, such as the Simplified Scanning Arrangements, Utilisation of High Fly-Back Voltage Peaks for generation of Anode Voltage, etc.].—J. G. Weiss. (*Telefunken-Hausmitteilungen*, July 1939, Vol. 20, No. 81, pp. 9–12.) *See* also *Wireless World*, 17th Aug. 1939, Vol. 45, No. 7, pp. 149–150.

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4601. THE DEVELOPMENT OF THE "UNIT TELEVISION RECEIVER" [including Comparative Prices of English & American Receivers]: *also* THE UNIT TELEVISION RECEIVER E1: RAY DEFLECTION AND HIGH-VOLTAGE GENERATION IN THE UNIT TELEVISION RECEIVER E1: *and* THE IMAGE-REPRODUCING TUBE OF THE UNIT TELEVISION RECEIVER.—Weiss: Andrieu & Rudert: Mulert & Urtel: Knoblauch & Schwartz. (*T.F.T.*, July 1939, Vol. 28, No. 7, pp. 246–249: 249–257: 257–264: and 264–267.)

4602. A TESTING EQUIPMENT FOR MEASUREMENT OF THE FREQUENCY CHARACTERISTIC OF THE UNIT TELEVISION RECEIVER.—P. Deserno & M. Messner. (*T.F.T.*, July 1939, Vol. 28, No. 7, pp. 267–271.)

4603. THE "UNIT" TELEVISION BROADCAST RECEIVING AERIAL.—Roosenstein. (*See* 4422.)

4604. TELEVISION RECEIVING AERIALS.—Roosenstein. (*See* 4421.)

4605. NEW TELEVISION AERIAL ["Tilted-Wire" Aerial, Easier to Install and Less Conspicuous: Anti-Interference Properties].—(*Wireless World*, 31st Aug. 1939, Vol. 45, pp. 206–207.)

4606. THE AUTOMATIC [Facsimile] TELEGRAPH.—G. W. Janson. (*Communications*, April 1939, Vol. 19, No. 4, pp. 12–13 and 16.) *See* also 3256 of August.

4607. HIGH-SPEED FOUR-COLUMN FACSIMILE RECORDER.—Finch Laboratories. (*Electronics*, May 1939, Vol. 12, No. 5, pp. 61 and 62.)

MEASUREMENTS AND STANDARDS

4608. ON THE MEASUREMENT OF HIGH RESISTANCE AT HIGH [and Ultra-High] FREQUENCIES [by reading Resonance-Current Deflection of Thermojunction/M.C.-Galvanometer Combination without and with the Resistance shunting Variable Condenser: Discussion of Errors].—M. Saito. (*Rep. of Rad. Res. in Japan*, [dated] Dec. 1938, Vol. 8, No. 3, Abstracts p. 19.)

4609. COMPENSATOR FOR THE RADIATION METHOD OF MEASURING OSCILLATOR EFFICIENCY.—Cowan. (*See* 4461.)

4610. VACUUM THERMOCOUPLES OF THE RADIATION TYPE [sensitive to Light and Heat Waves: for Radiation Pyrometry and Other Applications].—S. S. Stack. (*Gen. Elec. Review*, Aug. 1939, Vol. 42, No. 8, pp. 365–366.)

4611. HIGH-Q TANK CIRCUIT FOR ULTRA-HIGH FREQUENCIES.—Peterson. (*See* 4366.)

4612. EQUIVALENCE OF TWO PIEZOELECTRIC OSCILLATING QUARTZ CRYSTALS OF SYMMETRICAL OUTLINES WITH RESPECT TO A PLANE PERPENDICULAR TO AN ELECTRICAL AXIS [New Theorem serving as Criterion of Equivalence].—I. Koga. (*Electrot. Journ.*, Tokyo, Aug. 1939, Vol. 3, No. 8, pp. 185–186.)

4613. PIEZOELECTRICITY OF POTASSIUM PHOSPHATE.—Lüdy. (*See* 4488.)

4614. MAGNETOSTRICTION RESONATORS USING LAMINATED NICKEL VIBRATORS.—Fukushima & Koitibara. (In paper dealt with in 4336, above.)

4615. MULTI-WINDING MAGNETOSTRICTION VIBRATOR [primarily for Wave Filters].—T. Hayasaka. (*Nippon Elec. Comm. Eng.*, July 1939, No. 17, pp. 51–52: short summary only.)

4616. THE PRECISE MEASUREMENT OF RADIO FREQUENCIES.—E. Montuschi. (*U.R.S.I. Proc. of* 1938 *Gen. Assembly*, Fasc. 1, Vol. 5, 1938, pp. 349–359: in Italian.)

4617. REPORT ON THE RESULTS OF MEASUREMENTS MADE AT THE P.T.R., 12TH/13TH MARCH 1935 [1000 c/s Modulation from N.P.L. on Three B.B.C. Waves.].—E. Giebe. (*U.R.S.I. Proc. of* 1938 *Gen. Assembly*, Fasc. 1, Vol. 5, 1938, pp. 324–326: in English.)

4618. DIFFERENTIAL CONDENSER METHOD OF MEASURING DIELECTRIC LOSS ANGLES AT HIGH FREQUENCIES [Series-Substitution Method modified by Use of Differential-Condenser/Resistance Combination as a Continuously Variable Resistance: Simple & Accurate Arrangement].—B. Itijo. (*Electrot. Journ.*, Tokyo, Aug. 1939, Vol. 3, No. 8, p. 188.)

4619. DYNATRON METHOD OF [Measurement of] DIELECTRIC LOSS ANGLES AT H.F. [using a Pentode: Necessity for Very Precise Variation of First-Grid Bias Voltage owing to Steepness of Negative-Conductance Characteristic (making Measurement of Small Loss Angles Difficult): Improved Method keeping This Bias Voltage Constant—"Anode-Voltage-Adjustment" Method].—S. Okazaki & I. Ohtsuka. (*Electrot. Journ.*, Tokyo, Aug. 1939, Vol. 3, No. 8, pp. 191–192.)

4620. A WIDE-RANGE HIGH-VOLTAGE ELECTROSTATIC VOLTMETER.—F. H. Nadig & J. Ll. Bohn. (*Phys. Review*, 15th July 1939, Series 2, Vol. 56, No. 2, p. 216: abstract only.)

4621. MEASUREMENT OF CHOPPED IMPULSE VOLTAGES BY THE RIKEN CREST VOLTMETER [Investigation of Time Lag for Waves of Various Steepnesses].—Y. Ishiguro & Y. Gosho. (*Electrot. Journ.*, Tokyo, Aug. 1939, Vol. 3, No. 8, pp. 189–190.)

4622. IMPULSE TESTING USING CATHODE-RAY OSCILLOSCOPE EQUIPMENT.—Siezen. (*See* 4654.)

4623. AN IMPULSE MEASURING SET [measuring Crest Amplitude and Decay to Specified Level].—Grant & Macnee. (*See* 4464.)

4624. A PRECISION METHOD FOR THE MEASUREMENT OF THE MUTUAL CONDUCTANCE OF THERMIONIC VALVES.—Astbury. (*See* 4462.)

4625. A METHOD OF MEASURING VACUUM-TUBE COEFFICIENTS.—Polk. (*See* 4463.)

4626. FREQUENCY - INDEPENDENT CAPACITIVE-OHMIC VOLTAGE DIVIDERS FOR MEASURING PURPOSES [Advantages over Capacitive and Ohmic Types: Analysis & Construction of the Two-Stage Divider: the Uniformly Stepped Divider (3 Types): Frequency Limit at which Uniformly Distributed Earth-Capacities introduce Errors]. — O. Zinke. (*E.T.Z.*, 3rd Aug. 1939, Vol. 60, No. 31, pp. 927–930.)

4627. BRIDGE FOR THE DIRECT MEASUREMENT OF IMPEDANCES.—Chrétien. (*See* 4524.)

4628. IMPEDANCE MEASUREMENTS ON BROADCAST ANTENNAS.—Sinclair. (*See* 4432.)

4629. RADIO-FREQUENCY BRIDGE [for Accurate Measurement, between 20 kc/s and 2 Mc/s, of Impedances of Aerials, Transmission Lines, Resistances, etc.].—Muirhead Ltd. (*Journ. of Scient. Instr.*, Sept. 1939, Vol. 16, No. 9, pp. 314–315.) From a P.O. design.

4630. ON FRAME RECEIVING AERIALS [for Field-Strength Measurement].—Koch. (*See* 4426.)

4631. A WIDE - RANGE WHEATSTONE BRIDGE [Range of 10^{13}: suitable for Precision Measurements and Production Checking].—J. Avins. (*Electronics*, July 1939, Vol. 12, No. 7, pp. 38. .50.)

4632. A VALVE WATTMETER [working on Differential Action of Four Triodes operating on Non-Linear Parts of Characteristics: Frequencies 0–20 kc/s, but Circuit adaptable to Much Higher Frequencies].—D. M. Myers & W. K. Clothier. (*Journ. of Scient. Instr.*, Sept. 1939, Vol. 16, No. 9, pp. 302–309.)

4633. A SELF-CHECKING VACUUM-TUBE VOLTMETER.—R. C. Paine. (*Electronics*, June 1939, Vol. 12, No. 6, pp. 60. .64.)

4634. ACCURATE A.C. POTENTIOMETER MEASUREMENTS [Comparison of A.C. and D.C. Currents by Bolometric Method].—W. Diamand & H. Dziewulski. (*Journ. of Scient. Instr.*, Aug. 1939, Vol. 16, No. 8, pp. 264–268.)

4635. STABILISATION OF VARIABLE HIGH-VOLTAGE D.C. [allowing Use of Mains Supply for Accurate Measurement of Leakage Conductance of Condensers: Effective Constancy of 5 in 10^5 for 3% Fluctuations].—W. Hackett. (*Journ. of Scient. Instr.*, Sept. 1939, Vol. 16, No. 9, pp. 297–302.)

4636. CORRECTIONS TO "AMPLIFIER TESTING BY MEANS OF SQUARE WAVES."—G. Swift. (*Communications*, July 1939, Vol. 19, No. 7, p. 24.) *See* 2023 of May.

4637. STANDARDISATION OF TESTS ON RECEIVERS.—(*See* 4416.)

4638. INSTRUMENTS INCORPORATING THERMIONIC VALVES, AND THEIR CHARACTERISTICS: PART II [D.C. Voltages: Wattmeters: Harmonic Analysers: etc.].—James, Warren, & Polgreen. (*G.E.C. Journal*, Aug. 1939, Vol. 10, No. 3, pp. 183–191.) For Part I *see* 3283 of August.

4639. A NEEDLE VIBRATION GALVANOMETER OF HIGH SENSITIVITY.—W. Rump. (*Physik. Zeitschr.*, 1st Aug. 1939, Vol. 40, No. 15, pp. 493–500.)

4640. AN IMPROVED DISPOSITION FOR MIRROR, POINTER, AND SCALE IN PRECISION INSTRUMENTS.—G. O. Forester. (*Journ. of Scient. Instr.*, Aug. 1939, Vol. 16, No. 8, pp. 268–269.)

4641. STATIC CURRENT TRANSFORMERS FOR THE MEASUREMENT OF CONTINUOUS CURRENT.—Vassilière-Arlhac. (*Rev. Gén. de l'Élec.*, 15th July 1939, Vol. 46, No. 2, pp. 54–56.)

SUBSIDIARY APPARATUS AND MATERIALS

4642. THE COLD-CATHODE-RAY OSCILLOGRAPH FOR VERY LOW EXCITING VOLTAGES.—Thielen. (*Arch. f. Elektrot.*, 12th July 1939, Vol. 33, No. 7, pp. 487–490.)

This tube (scheme of vertical section, Fig. 1) uses an auxiliary discharge working under the most favourable conditions with opposing cathodes and magnetic field, and an increased initial voltage to extract the electrons, with subsequent retardation of the electron beam. Oscillograms (Figs. 4–6) are given to show that the recording efficiency is considerable even at very low voltages (of the order of 1000 v). The use of special films of high sensitivity is important (Fig. 6). *See* also Rogowski, Malsch, Westermann, Abstracts, 1933, pp. 283 & 516, and 1935, p. 629 & back reference.

4643. ELECTROSTATIC DEFLECTION IN CATHODE-RAY TUBES WITH NON-PARALLEL [Sloping or Bent] DEFLECTING PLATES.—Flechsig. (*E.T.Z.*, 6th July 1939, Vol. 60, No. 27, p. 798: summary only.)

Calculation for the bending of deflecting plates to obtain the highest possible sensitivity; quantitative comparison between similar tubes with slanting plane plates and bent plates—slanting produced a gain of 112%, while bending gave an additional gain of 43%.

4644. NEW INVESTIGATIONS ON CATHODE-RAY OSCILLOGRAPHS: IV—A BALLISTIC MODEL OF THE C-R TUBE: OSCILLATION GENERATION BY A CATHODE RAY IN THE FIELD OF A PLATE CONDENSER, TAKING INTO CONSIDERATION THE ACTION OF THE STRAY FIELDS [and a Section on the Conductivity and Dielectric Constant of an Electron Stream].—Thoma. (*Funktech. Monatshefte*, June 1939, No. 6, pp. 175–180.) For previous parts *see* 3704 of September.

4645. "CATHODE-RAY TUBES" [English Translation, brought Up-to-Date: Book Review].—von Ardenne. (*Journ. of Scient. Instr.*, Aug. 1939, Vol. 16, No. 8, p. 275.)

4646. AN OSCILLOSCOPE FOR THE DETERMINATION OF CHARACTERISTIC CURVES.—Douma & Zijlstra. (*See* 4460.)

4647. INFLUENCE AND CONTROL OF THE FORM OF THE CHARGES MOVING PERIODICALLY IN ELECTRON VALVES, PARTICULARLY IN THE SHOCK EXCITATION OF SHORT-WAVE OSCILLATIONS [and the Possibility of applying Velocity Modulation to Ionic Tubes].—Jobst. (*See* 4354.)

4648. IMPEDANCE PROPERTIES OF ELECTRON STREAMS.—Peterson. (*See* 4448.)

4649. REPRESENTATION OF THE PLANAR MOTION OF ELECTRONS IN MAGNETIC AND ELECTRIC FIELDS BY COMPLEX VECTOR LOCI.—Kleinwächter. (*See* 4449.)

4650. ABERRATION OF THE GEOMETRICAL ELECTRON-OPTICS OF FIFTH ORDER [using the Seidel Eikonal: Possibility of Six Aberrations not existing in Ordinary Geometrical Optics].—Inoue. (*Electrot. Journ.*, Tokyo, Aug. 1939, Vol. 3, No. 8, pp. 178–180.)

4651. PRELIMINARY INVESTIGATION OF CATHODE RAYS [Penetration into Various Substances: Possible Application to Therapy].—Trump, van de Graaff, & Cloud. (*Phys. Review*, 15th July 1939, Series 2, Vol. 56, No. 2, p. 215: abstract only.)

4652. A NEW HARD-VALVE RELAXATION OSCILLATOR.—Black. (*See* 4580.)

4653. IMPROVEMENTS IN THE TIME-BASE ARRANGEMENTS OF CATHODE-RAY OSCILLOGRAPHS FOR THE STUDY OF PERIODIC ELECTRICAL PHENOMENA [including the Use of a Direct-Reading Frequency Meter synchronised with the Time-Base Voltage].—Legros. (*Rev. Gén. de l'Élec.*, 9th Sept. 1939, Vol. 46, No. 10, pp. 309–319.) For the meter in question *see* 2923 of 1938.

4654. IMPULSE TESTING USING CATHODE-RAY OSCILLOSCOPE EQUIPMENT [with Special Time-Base Arrangement providing for "Microscopic" Examination of Spontaneous Transient Phenomena, for Simultaneous Observation of Two Phenomena by Electronic Switching, and for Generation of Testing Impulses and Examination of Their Distortion].—Siezen. (*Wireless Engineer*, Aug. 1939, Vol. 16, No. 191, pp. 391–399.)

4655. A "HARD" VALVE ELECTRONIC RELAY SWITCH [for Simultaneous Delineation on C-R Oscillograph: Switching Frequencies 15–13 000 c/s].—Clothier. (*Journ. of Scient. Instr.*, Sept. 1939, Vol. 16, No. 9, pp. 285–290.)

4656. AN OPERATIONAL TREATMENT OF THE DESIGN OF ELECTRO-MAGNETIC TIME-BASE AMPLIFIERS.—Jofeh. (*See* 4581.)

4657. ON THE DEVELOPMENT OF THE CATHODE-RAY FLUORESCENT SCREEN.—Schleede & Bartels. (*See* 4572.)

4658. SOME OPTICAL PROPERTIES OF ZINC-SILICATE PHOSPHORS [the Two Emission Bands, Each with a Maximum, and the Three Absorption Regions], *and* FUNDAMENTAL ABSORPTION OF ZnS-MnS AND ZnS-CdS-MnS MIXED CRYSTALS.—Kröger. (*Physica*, Aug. 1939, Vol. 6, No. 8, pp. 764–778: pp. 779–784: in English.) For previous work on mixed crystals see 2501 of June.

4659. SIMILARITY OF MECHANISMS OF ZINC-SULPHIDE PHOSPHORS AND SELENIUM PHOTOELEMENTS.—Goos. (In paper dealt with in 4588, above.)

4660. ZONE THEORY AND THE PROPERTIES OF SULPHIDE PHOSPHORS [Theory yields Model of Phosphor giving Qualitative Explanation of Properties].—Johnson. (*Phys. Review*, 15th July 1939, Series 2, Vol. 56, No. 2, p. 213: abstract only.)

4661. PHOTOCONDUCTIVITY OF CRYSTALLINE WILLEMITE AT LOW TEMPERATURES.—Hofstadter & Herman. (*Phys. Review*, 15th July 1939, Series 2, Vol. 56, No. 2, p. 212: abstract only.)

4662. ON THE FLUORESCENCE OF AQUEOUS SOLUTIONS OF TERBIUM [and the Spectrum of a Phosphor activated by Terbium].—Seidel & others. (*Journ. of Phys.* [of USSR: replacing *Tech. Phys. of USSR*], No. 1, Vol. 1, 1939, pp. 67–77: in English.)

4663. A FIRE-FLY "SPINTHARISCOPE."—Wood. (*Science*, 8th Sept. 1939, Vol. 90, pp. 233–234.)

4664. NUMBER OF QUANTA REQUIRED TO FORM THE PHOTOGRAPHIC LATENT IMAGE AS DETERMINED FROM MATHEMATICAL ANALYSIS OF THE H AND D CURVE.—Webb. (*Journ. Opt. Soc. Am.*, Aug. 1939, Vol. 29, No. 8, pp. 309–313.) *See* also pp. 314–326 for a companion paper.

4665. ON THE SENSITIVITY OF PHOTOGRAPHIC EMULSIONS FOR ELECTRONS BETWEEN 50 AND 100 keV [Experimental Results giving Relative Values and permitting Choice of Best Emulsion for Electron Microscopy or Similar Purposes].—Marton. (*Phys. Review*, 1st Aug. 1939, Series 2, Vol. 56, No. 3, p. 290.)

4666. CATHODE-RAY-TUBE PHOTOGRAPHY.—Rogers & Robertson. (*Electronics*, July 1939, Vol. 12, No. 7, p. 19.)

4667. CATHODE-RAY PHOTOGRAPHY: MAKING PERMANENT RECORDS FROM OSCILLOSCOPES AND TELEVISION SCREENS.—Jupe. (*Wireless World*, 7th Sept. 1939, Vol. 45, No. 10, pp. 233–234.)

4668. ON THE RELATION BETWEEN THE TRANSMISSION OF LIGHT AND THE CONDUCTION OF ELECTRICITY IN THIN FILMS.—Saito. (*See* 4584.)

4669. CATHODE SPUTTERING [Empirical Relationship between Rate of Sputtering of Various Metals and Total Heat Required to Evaporate Metal: New Theory involving Double Evaporation Process].—Starr. (*Phys. Review*, 15th July 1939, Series 2, Vol. 56, No. 2, pp. 216–217: abstract only.)

4670. PORCELAIN/METAL CEMENT [Notice of E.R.A. Reports].—Wedmore. (*Electrician*, 22nd Sept. 1939, Vol. 123, p. 292.)

4671. INSENSITIVE NEEDLE VALVE [for maintaining Accurate Pressure in Cyclotron].—Stallmann & Kruger. (*Review of Scient. Instr.*, Aug. 1939, Vol. 10, No. 8, p. 242.)

4672. MEASUREMENT OF THE RADIO-FREQUENCY VOLTAGE IN A CYCLOTRON.—Danforth & Sampson. (*Journ. Franklin Inst.*, Aug. 1939, Vol. 228, No. 2, pp. 233–234.) Condensed from paper referred to in 3312 of 1938.

4673. AN INVESTIGATION OF THE LINEAR ACCELERATOR [to determine Limitations of Voltage and Beam Intensity, etc.].—Hartman & Smith. (*Review of Scient. Instr.*, Aug. 1939, Vol. 10, No. 8, pp. 223–231.)

4674. THE INDUSTRIAL PRODUCTION AND UTILISATION OF KRYPTON.—(*Génie Civil*, 2nd Sept. 1939, Vol. 115, No. 10, pp. 198–200.) *See* also 162 of January (Klemperer).

4675. ELECTRODE CONSUMPTION DUE TO ARC DISCHARGE [in Various Gases & Vapours].—Hoh. (*Electrot. Journ.*, Tokyo, May 1939, Vol. 3, No. 5, pp. 99–103.)

4676. TUNGSTEN-ROD TREATING EQUIPMENT.—Eisler Company. (*Electronics*, March 1939, Vol. 12, No. 3, pp. 72..75.)

4677. ULTRA-HIGH-FREQUENCY DISCHARGES IN AIR [Wavelengths around 2 m: Effects corresponding to Usual Glow, Glow-and-Arc, & Arc Discharges, but also a New Kind of Corona Discharge (Height reaching 25 cm)]—Owaki. (*Electrot. Journ.*, Tokyo, Sept. 1939, Vol. 3, No. 9, pp. 213–214.)

4678. INDICATORS FOR ARC-BACK IN MERCURY-VAPOUR RECTIFIERS [for Broadcasting Stations].—Logan. (*Electronics*, April 1939, Vol. 12, No. 4, pp. 48..51.)

4679. PHASE SHIFTERS FOR GRID-CONTROLLED DISCHARGE TUBES [General Study of Various Circuits].—Kusakari. (*Electrot. Journ.*, Tokyo, May 1939, Vol. 3, No. 5, pp. 115–118.)

4680. NEW INVERTING METHOD USING MECHANICAL COMMUTATOR AND GRID-CONTROLLED MERCURY-ARC RECTIFIER.—Watanabe & Outi. (*Electrot. Journ.*, Tokyo, June 1939, Vol. 3, No. 6, pp. 133–139.)

4681. THE ELECTRIC SCREENING EFFECT OF THE GRID: CORRECTIONS.—Ikeda. (*Electrot. Journ.*, Tokyo, May 1939, Vol. 3, No. 5, p. 106.) *See* 2095 of May.

4682. THE SEMICONDUCTOR THEORY OF BARRIER-LAYER AND POINT RECTIFIERS.—Schottky. (*Zeitschr. f. Physik*, No. 5/6, Vol. 113, 1939, pp. 367–414.) The full theory, a preliminary account of which was referred to in 1685 of April.

4683. THE COPPER-OXIDE RECTIFIER [with Literature and Patent References].—Dubar. (*Rev. Gén. de l'Élec.*, 29th July 1939, Vol. 46, No. 4, pp. 99–116.)

4684. APPLICATIONS OF COPPER-OXIDE RECTIFIERS [Small Type (3/16th-Inch Disc), in Wireless and Carrier Telephone Systems: Survey].—Beranek. (*Electronics*, July 1939, Vol. 12, No. 7, pp. 14–18 and 68..71.)

4685. SOME INDUSTRIAL APPLICATIONS OF SELENIUM RECTIFIERS, *and* [Selenium] RECTIFIER POWER PLANT FOR TRANSMISSION SYSTEMS.—Scruby & Giroz: Kelly. (*Elec. Communication*, April 1939, Vol. 17, No. 4, pp. 366–374: May 1939, Vol. 18, No. 1, pp. 60–64.)

4686. ELECTRON CONDUCTION IN CRYSTALS.—Hilsch. (*See* 4585.)

4687. A PORTABLE MOTOR-DRIVEN APPARATUS FOR DEPOSITING BUILT-UP MOLECULAR FILMS.—Gregg & Widdowson: Blodgett. (*Review of Scient. Instr.*, Aug. 1939, Vol. 10, No. 8, pp. 236–237.) *Cf.* 3407 of August and back reference; *also* 3749 of September.

4688. ELECTRIC BREAKDOWN OF AMORPHOUS MATERIALS [Varying Condition of Stress in Phenolite during Constant-Voltage-Impression Breakdown studied by Polarised-Light Method].—Shimizu & Takahasi. (*Electrot. Journ.*, Tokyo, June 1939, Vol. 3, No. 6, p. 142.)

4689. THE DIELECTRIC PROPERTIES OF INSULATING MATERIALS: III—ALTERNATING AND DIRECT CURRENT CONDUCTIVITIES [for Dielectrics showing Anomalous Dispersion: Initial D.C. Conductivity is equal to Limiting Value of A.C. Conductivity at High Frequencies: the Two Types of Conductivity possessed by Such Dielectrics: etc.].—Murphy & Morgan. (*Bell S. Tech. Journ.*, July 1939, Vol. 18, No. 3, pp. 502–537.) For previous parts *see* 766 of February.

4690. TEMPERATURE RISE OF INSULATING MATERIALS IN H.F. ELECTRIC FIELD [1.55 Mc/s: Temperature Rise, in general, is nearly proportional to Square of Applied Voltage, and is Large when $\epsilon \tan \delta$ is Large: "but Relation is Not so Simple"].—Okazaki. (*Electrot. Journ.*, Tokyo, Sept. 1939, Vol. 3, No. 9, p. 211.)

4691. THE THERMAL AND ELECTRICAL PROPERTIES OF THE COATING OF SYNTHETIC RESINS [Comparison of Phenolic, Polystyrene, & Urea Resins, etc.].—Shimizu & Inai. (*Electrot. Journ.*, Tokyo, Sept. 1939, Vol. 3, No. 9, pp. 203–208.)

4692. POLYSTYRENE [and Its Recent Improvements].—(*Wireless World*, 28th Sept. 1939, Vol. 45, p. 297.)

4693. POLYSTYRENE FILM [Ribbons for Roll-Type Condensers, etc.].—Bakelite Corporation. (*Electronics*, Aug. 1939, Vol. 12, No. 8, pp. 64 and 65.)

4694. "INDUCTIVE" AND "ANTI-INDUCTIVE" PAPER CONDENSERS.—Ferrari. (*Boll. del Centro Volpi di Elett.*, English Edition, Jan./March 1939, Year 2, No. 1, p. 19d.)

4695. THE INFLUENCE OF THE SELF-INDUCTANCE OF ROLL-TYPE CONDENSERS ON THEIR IMPEDANCE.—Linder & Schniedermann. (*See* 4330.)

4696. MOULDED SILVER/MICA CONDENSERS [with Special Precautions to prevent Splitting of Mica through Wide Temperature Variations].—Erie Resistor Corporation. (*Proc. Inst. Rad. Eng.*, Aug. 1939, Vol. 27, No. 8, p. ii.)

4697. MORE ON PRESSURE CAPACITORS [the Johnson Pressure Condenser using Seamless Steel and Pyrex Glass Construction].—(*Electronics*, Aug. 1939, Vol. 12, No. 8, p. 60.) Continued from 3743 of September.

4698. CERAMIC TRIMMER CONDENSERS.—United Insulator Company. (*Journ. of Scient. Instr.*, Aug. 1939, Vol. 16, No. 8, pp. 273–274.)

4699. INSULATING MATERIAL OF GLASS FLUX AND MICA DUST.—(*Scient. American*, Aug. 1939, Vol. 161, No. 2, p. 107: paragraph only.)

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4707. EFFECT OF HUMIDITY ON IMPULSE FLASH-OVER VOLTAGES OF ROD GAPS AND INSULATORS [Tests using the "Riken Crest Voltmeter"].—Ishiguro. (*Electrot. Journ.*, Tokyo, July 1939, Vol. 3, No. 7, pp. 147–152.) For this voltmeter *see* 4621, above.

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4710. TEMPERATURE AGING CHARACTERISTICS OF CLASS A INSULATION, *and* TEMPERATURE LIMITS SET BY OIL AND CELLULOSE INSULATION.—Smith & Scott: Hill. (*Elec. Engineering*, Sept. 1939, Vol. 58, No. 9, Transactions pp. 435–444: pp. 484–490.)

4711. DISCHARGES IN A TWO-LAYER DIELECTRIC WITH IMPULSIVE VOLTAGES [Phenomena between Two Electrodes in Oil and Oil/Air Dielectrics: Photographs showing Development of Discharge Canals and Effect of Charges on Oil/Air Boundary Surface].—Honda. (*Arch. f. Elektrot.*, 12th July 1939, Vol. 33, No. 7, pp. 458–465.)

4712. PROPERTIES OF WHALE OIL AS INSULATING VARNISH.—Shimizu & Inai. (*Electrot. Journ.*, Tokyo, Sept. 1939, Vol. 3, No. 9, pp. 210–211.)

4713. A NOTE ON TEST CODE OF RUBBER-INSULATED WIRES [in testing for Ozone Cracking].—Kumagai & others. (*Electrot. Journ.*, Tokyo, June 1939, Vol. 3, No. 6, pp. 139–141.)

4714. DESIGN AND PERFORMANCE OF A VOLTAGE REGULATOR [using 2 W Neon Lamp to provide Cathode Bias in Control Valve].—RCA Radiotron. (*Electronics*, March 1939, Vol. 12, No. 3, pp. 48 and 50.)

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4718. [Provisional] STANDARDS FOR GALVANIC ELEMENTS AND BATTERIES.—VDE. (*E.T.Z.*, 24th Aug. 1939, Vol. 60, No. 34, pp. 1015–1018.)

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4720. POWER FROM THE WIND: ITS USES FOR ACCUMULATOR CHARGING.—Beatt. (*See* 4409.)

4721. LIGHT-WEIGHT INDUCTION MOTOR [11 H.P., at 5.18 kg per H.P.].—Ohsumi. (*Electrot. Journ.*, Tokyo, Aug. 1939, Vol. 3, No. 8, p. 188.)

4722. MIDGET PETROL MOTORS BY MASS PRODUCTION [One-Sixth Horse-Power, about Four Inches High: for Model Aeroplanes].—Pope. (*Scient. American*, Sept. 1939, Vol. 161, No. 3, pp. 144–145.)

4723. SURVEY OF MAGNETIC MATERIALS AND APPLICATIONS IN THE TELEPHONE SYSTEM.—Legg. (*Bell S. Tech. Journ.*, July 1939, Vol. 18, No. 3, pp. 438–464.)

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4725. SUPERSTRUCTURE IN $FeNi_3$.—Haworth. (*Phys. Review*, 1st Aug. 1939, Series 2, Vol. 56, No. 3, p. 289.) Confirmation of results of Leech & Sykes (3352 of August) and discussion.

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4728. STRIPPING COTTON AND SILK FROM WIRE ENDS [by Incandescent Electrodes.]—Chase. (*Electronics*, June 1939, Vol. 12, No. 6, p. 66.) Used in the Stromberg-Carlson works.

4729. NOTE ON SPARK-RECORDING OF DATA [and Its Advantages].—Tuttle. (*Review of Scient. Instr.*, Aug. 1939, Vol. 10, No. 8, pp. 234–235.)

4730. "PROTECTIVE COATINGS FOR METALS" [Book Review].—Burns & Schuh. (*Bell S. Tech. Journ.*, July 1939, Vol. 18, No. 3, pp. 538–539.)

STATIONS, DESIGN AND OPERATION

4731. REMARKS ON SINGLE-SIDEBAND WORKING IN TELEVISION.—Urtel. (*See* 4547.)

4732. THE TRANSMISSION OF WIDE FREQUENCY-BANDS OVER CABLE [in Television, Wire Broadcasting, etc: Survey: 1939 Berlin Exhibition Lecture].—Agricola. (*Zeitschr. V.D.I.*, 29th July 1939, Vol. 83, No. 30, pp. 869–877.)

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4734. THE GERMAN POLICE WIRELESS NETWORK.—Schlake. (*Lorenz Berichte*, June 1939, No. 1/2, pp. 37–42.)

4735. HIGHLY-DAMPED RADIO TRANSMISSION METHOD FOR INTERFERENCE TRANSMISSIONS.—S. A. F. A. R. & A. Castellani-Milano. (*Boll. del Centro Volpi di Elett.*, English Edition, Jan./March 1939, Year 2, No. 1, p. 133d.)

4736. MUTUAL INTERFERENCE IN AERONAUTICAL RADIO COMMUNICATION [with Same Wavelength for Aircraft & Ground Station: the Probability of Delay as a Function of "Communication Density"].—H. Matsudaira. (*Nippon Elec. Comm. Eng.*, May 1939, No. 16, p. 633: summary only.)

4737. POINTS ON WIRELESS APPARATUS IN AIRCRAFT [including Effects of High-Altitude Flying].—Viehmann & others. (*Zeitschr. V.D.I.*, 5th Aug. 1939, Vol. 83, No. 31, pp. 909–911.)

4738. "AERONAUTIC RADIO" [Installation, Use, and Maintenance: Book Review].—Eddy. (*Electronics*, Aug. 1939, Vol. 12, No. 8, p. 37.)

4739. EXPERIMENT ON THE BROADCASTING OF WEATHER CHARTS BY RADIO.—Niwa & Hayashi. (*Journ. Inst. of Elec. Comm. Eng of Japan*, Nov. 1938: in Japanese.)

4740. LORENZ WIRELESS APPARATUS IN THE "TRIPPEL" AUTO [Amphibian Motor Car] ON ITS SEA-TRIAL VOYAGE.—(*Lorenz Berichte*, June 1939, No. 1/2, pp. 69 and 70.)

4741. HIGH-FREQUENCY WIRE BROADCASTING [in Germany: Reasons for adoption of Telephone (as against Electricity-Supply) Network: Requirements, Circuits, etc., of the Various Components: Lay-Out: Monitoring and Testing: Ranges: etc.].—Budischin & Deklotz. (*E.T.Z.*, 3rd Aug. 1939, Vol. 60, No. 31, pp. 913–922.)

4742. CARRIER TELEPHONE SYSTEM USING LIGHTING AND POWER DISTRIBUTION LINES.—Shinohara, Hirano, & Yoshioka. (*Nippon Elec. Comm. Eng.*, July 1939, No. 17, pp. 24–39.)

4743. PM-5 Portable Radio Set [One-Load Set with 0.3–0.4 W in Aerial: Wavelengths (*e.g.*) 40–70 m].—Bell Tel. Company, Antwerp. (*Elec. Communication*, July 1939, Vol. 18, No. 1, p. 111.)

4744. Midget Marine Radio Telephone [for Yachts, etc.].—Western Electric. (*Scient. American*, Sept. 1939, Vol. 161, No. 3, pp. 168 and 169.) *Cf.* 3368 of August: for a yacht D.F. set *see* 4482, above.

4745. The European Broadcasting Conference, Montreux, 1939.—Hornung. (*Telefunken-Hausmitteilungen*, July 1939, Vol. 20, No. 81, pp. 109–118.) *Cf.* also *Bull. Assoc. suisse des Élec.*, No. 19, Vol. 30, pp. 648–650, and *Rev. Gén. de l'Élec.*, 5th Aug. 1939, Vol. 46, No. 5, pp. 151–158.

4746. Rules and Standards for Broadcast Stations [Review of the New F.C.C. Rules]. —Guy. (*Electronics*, Aug. 1939, Vol. 12, No. 8, pp. 11–13 and 67. 70.)

4747. The Preliminary Calculations of a Broadcasting Station [Introduction to a Paper on the Eckersley Graphical Method: with Values of Absorption Constant for Various Types of Terrain].—(*Lorenz Berichte*, June 1939, No. 1/2, pp. 43–49.) The paper will be published shortly in a special number.

4748. The Empire Service Broadcasting Station at Daventry.—Hayes & MacLarty. (*Journ. I.E.E.*, Sept. 1939, Vol. 85, No. 513, pp. 321–357: Discussions pp. 358–369.)

4749. Athlone Short-Wave Broadcaster [with High-Stability Variable-Frequency Master-Oscillator, 15–80 m].—(*Elec. Communication*, April 1939, Vol. 17, No. 4, p. 398.)

4750. Short-Wave Broadcasting in India [and the Choice of Wavelengths].—(*Sci. & Culture*, Calcutta, Aug. 1939, Vol. 5, No. 2, pp. 99–100.)

4751. The Stolp Broadcasting Station [with Ring of Six Towers and a Central Tower, as Anti-Fading Aerial: Successfully Tested, Now in Service].—(*T.F.T.*, July 1939, Vol. 28, No. 7, p. 290.)

4752. Programme-Failure Alarm for Broadcasting Stations.—Chinn & Moe. (*Electronics*, July 1939, Vol. 12, No. 7, pp. 24–25.)

GENERAL PHYSICAL ARTICLES

4753. Report on the Limits between which the Approximate Methods of Geometrical Optics are Valid in Wave Optics, with Application to Radioelectric Waves.—Manneback. (*See* 4295.)

4754. Hamilton's Canonical Equations for the Motion of Wave Groups [starting from the Differential Wave Equation: Considerations of Effects of Gradients, Temperature Changes of Air, etc.].—Fokker. (*Physica*, Aug. 1939, Vol. 6, No. 8, pp. 785–790: in English.)

4755. The Diffraction of Electrons [Complete Explanation by Writer's Representation of Physical Space as a "Hyper-Ether"].—Loiseau. (*Rev. Gén. de l'Élec.*, 26th Aug. 1939, Vol. 46, No. 8, pp. 239–246.)

4756. Our Present Dilemma regarding the Values of the Natural Constants e, m, and h: a New Graphical Method of Presentation.—DuMond. (*Phys. Review*, 15th July 1939, Series 2, Vol. 56, No. 2, pp. 153–164.)

4757. A Multiple Nomogram for the Atomic Constants.—Beth. (*Phys. Review*, 15th July 1939, Series 2, Vol. 56, No. 2, pp. 208–209: abstract only.)

4758. The Radiofrequency Spectrum of the HD Molecule in Magnetic Fields.—Kellogg & others. (*Phys. Review*, 15th July 1939, Series 2, Vol. 56, No. 2, p. 213: abstract only.)

4759. On the Theory of Polarisability: I [Rigorous Quantum-Mechanical Proof of Silberstein's Formula: Approximate Expression applied to Helium Atom].—Biedermann. (*Physica*, Aug. 1939, Vol. 6, No. 8, pp. 717–720: in English.)

4760. "Lectures on Quantum Mechanics: Vol. I" [Book Review].—Siddiqi. (*Sci. & Culture*, Calcutta, July 1939, Vol. 5, No. 1, pp. 59–60.)

4761. "Introduction to Contemporary Physics: Second Edition" [Book Review].—Darrow. (*Electronics*, July 1939, Vol. 12, No. 7, p. 34.)

4762. Remark on the Fundamental Relations of Thermomagnetics.—Fokker. (*Physica*, Aug. 1939, Vol. 6, No. 8, pp. 791–796: in English.)

4763. A Classic Experiment, *and* Another Classic Experiment [Editorials on Wilson's Investigations of Lorentz-Larmor Theory *versus* Hertz Theory].—G.W.O.H. (*Wireless Engineer*, June 1939, Vol. 16, No. 189, pp. 271–273: July 1939, No. 190, pp. 327–329.)

4764. "The Fundamentals of Electromagnetism": Some Criticisms of a Restatement of Principles [in Book Review].—Howe: Cullwick. (*Electrician*, 22nd Sept. 1939, Vol. 123, pp. 289–290.) Criticism of Cullwick's ideas.

4765. New Representation of the "Distortion Power" of an Alternating Current with the Help of Functional Space [and the Introduction of the Idea of "Conjugate Voltage": Simpler than Budeanu's System]. —Quade. (*Arch. f. Elektrot.*, May 1939, Vol. 33, No. 5, pp. 277–305.)

MISCELLANEOUS

4766. "The Theory and Use of the Complex Variable" [and Conformal Transformation: Book Review].—Green. (*Journ. of Scient. Instr.*, Aug. 1939, Vol. 16, No. 8, p. 276.)

4767. ESTABLISHMENT BY THE AMERICAN MATHEMATICAL SOCIETY OF A NEW PERIODICAL [Abstracting Journal, *Mathematical Reviews*].—(*Science*, 25th Aug. 1939, Vol. 90, p. 175.)

4768. UTILISING HEAT FROM THE SUN [including the Abbot Automatic Solar Flash Boiler].—Abbot. (*Elec. Engineering*, July 1939, Vol. 58, No. 7, pp. 294–298.)

4769. ULTRA-HIGH-FREQUENCY DISCHARGES ON HEAT-RESISTING INSULATORS [Intense Light followed by Breakdown or Melting].—Okabe & Seya. (*Electrot. Journ.*, Tokyo, July 1939, Vol. 3, No. 7, p. 167.) The wavelength used was 80 cm.

4770. ELECTRICAL DISCHARGE OF A CONDUCTOR BY A HYPERSONIC AIR CURRENT [Current with Velocity greater than that of Sound: Characteristic Curves of Discharge as Function of Time and Velocity of Current].—Yadoff. (*Comptes Rendus*, 5th June 1939, Vol. 208, No. 23, pp. 1802–1804.) The discharge is very slow until the velocity of the air passes the value 385 m/s, when its rate begins to increase very rapidly. *See* also 1785 of 1938.

4771. THE POSITION IN OPTICAL TELEPHONY.—Kohler. (*Rev. Gén. de l'Élec.*, 8th July 1939, Vol. 46, No. 1, pp. 18–19.) Long summary of German paper referred to in 835 of February.

4772. A PORTABLE MOTOR-DRIVEN APPARATUS FOR DEPOSITING BUILT-UP MOLECULAR FILMS.—Gregg & Widdowson: Blodgett. (*Review of Scient. Instr.*, Aug. 1939, Vol. 10, No. 8, pp. 236–237.) *Cf.* 3407 of August and back reference; *also* 3749 of September.

4773. NON-DESTRUCTIVE THICKNESS MEASUREMENT OF ELECTRICALLY DEPOSITED OXIDE FILMS ON ALUMINIUM [by focusing Micrometer-Adjusted Microscope on Upper & Lower Surfaces of Film].—Dahl: Käpernick. (*Zeitschr. V.D.I.*, 24th June 1939, Vol. 83, No. 25, p. 752.)

4774. MICROMETRIC MEASUREMENTS WITH ELECTRIC WAVES [Short Survey of Ultra-Micrometer Circuits and Applications].—Hardung. (*Bull. Assoc. suisse des Élec.*, No. 7, Vol. 30, 1939, pp. 188–191.)

4775. SURFACE INDICATOR [for recording Smoothness of Metal or Painted Surfaces: Gramophone Pick-up Design].—Sams. (*Gen. Elec. Review*, Aug. 1939, Vol. 42, No. 8, p. 370.) "Variations of as little as one millionth of an inch are clearly indicated."

4776. INSTRUMENT FOR MEASURING SURFACE ROUGHNESS [Portable Profilometer].—Physicists Research Company. (*Journ. of Scient. Instr.*, Aug. 1939, Vol. 16, No. 8, pp. 274–275.)

4777. EVIDENCE FOR THE EXISTENCE OF AN ELECTRODYNAMIC FIELD IN LIVING ORGANISMS.—Burr & Northrop. (*Proc. Nat. Acad. Sci.*, June 1939, Vol. 25, No. 6, pp. 284–288.)

4778. ELECTRICITY EXISTS WHEREVER THERE IS LIFE: ELECTRICAL FIELD MAY DETERMINE NERVOUS STRUCTURE [Rotated Salamander produces Sine-Wave A.C. Output: etc.].—Burr & Harman. (*Sci. News Letter*, 17th June 1939, Vol. 35, p. 372.)

4779. A PRECISION DEVICE FOR FARADIC STIMULATION [giving Graded, Predetermined Impulses of Constant Wave Form: Condenser, Thyratron, Amplifier, and Resistances Combination].—Fender. (*Science*, 26th May 1939, Vol. 89, pp. 491–492.)

4780. CONCERNING A THESIS ON THE RADIOACTIVE PHENOMENA OF THE SECOND ORDER [from Electrified Insulators: Eichenberger's "Chemical Action" Explanation is Inadequate].—Reboul: Eichenberger. (*Journ. de Phys. et le Radium*, March 1939, Series 7, Vol. 10, No. 3, pp. 151–158.) *See* 790 of 1937.

4781. ELECTRICAL TEMPERATURE MEASUREMENTS IN PHYSIOLOGY [Use of Delicate Thermocouples, with Galvanometer/Photocell Combination: etc.].—Hill. (*Journ. I.E.E.*, Aug. 1939, Vol. 85, No. 512, pp. 313–314.) The method of electrical control of galvanometer characteristics (Schmitt, 3734 of 1938) was developed from this work.

4782. APPLICATION OF ULTRA-SHORT-WAVE POWER TO RADIOTHERMY [Estimation of Power by the "Double-Element" Method: Experiments on 4 Degrees of Sensation, with Wavelengths 5.4–6.2 m].—Awaya & Emi. (*Electrot. Journ.*, Tokyo, July 1939, Vol. 3, No. 7, pp. 167–168.)

4783. PRELIMINARY INVESTIGATION OF CATHODE RAYS [Penetration into Various Substances: Possible Application to Therapy].—Trump, van de Graaff, & Cloud. (*Phys. Review*, 15th July 1939, Series 2, Vol. 56, No. 2, p. 215: abstract only.)

4784. A STETHOPHONE AMPLIFIER.—Singer. (*Electronics*, June 1939, Vol. 12, No. 6, p. 66.)

4785. DETECTION OF RADIOACTIVE CONTAMINATION, USING [Readily Portable] GEIGER-MÜLLER COUNTERS.—Curtiss. (*Journ. of Res. of Nat. Bur. of Stds.*, July 1939, Vol. 23, No. 1, pp. 137–143.)

4786. A NEW METHOD FOR PHOTOELASTICITY IN THREE DIMENSIONS [using Polarisation caused by Scattering of Light within Cloudy Model in Place of Usual Analyser].—Weller. (*Phys. Review*, 15th July 1939, Series 2, Vol. 56, No. 2, p. 216: abstract only.)

4787. SPECTROSCOPY IN THE REGION OF RADIO FREQUENCY.—Kellogg & Others. (*Scientific Monthly*, Sept. 1939, Vol. 49, No. 3, p. 294.)

4788. SPECTRORADIOGRAPHY WITH THE CATHODE-RAY TUBE.—Graham & Müller. (*Journ. Opt. Soc. Am.*, June 1939, Vol. 29, No. 6, p. 258: summary only.)

4789. THE ELECTRIC STRAIN GAUGE.—Rusher & Matthews. (*Gen. Elec. Review*, April 1939, Vol. 42, No. 4, pp. 176–178.)

4790. NEW PATENT SHOWS NAVY'S METHOD OF DETECTING FLAWS [in Aeroplane Propellers, etc: Eddy-Current Method].—Gunn. (*Sci. News Letter*, 8th July 1939, Vol. 36, No. 2, p. 24.)

4791. PIEZOELECTRIC MEASUREMENTS ON A FREE-JET TURBINE.—Eilken. (*Zeitschr. V.D.I.*, 15th July 1939, Vol. 83, No. 28, p. 833.)

4792. EXPERIENCES WITH ELECTRICAL PRESSURE-RECORDING [using Piezoelectric Devices and a Capacity-Variation Ultramicrometer] ON HEAT ENGINES.—Watzinger & Larsen. (*Zeitschr. V.D.I.*, 5th Aug. 1939, Vol. 83, No. 31, pp. 889–901.)

4793. HIGH-FREQUENCY CHARACTERISTICS OF ROCKS [Measurements of Resistivity & Dielectric Constant of 4 Types of Rock at Wavelengths from 6 m to 200 m: in connection with Geophysical Prospecting].—Kadowaki. (*Electrot. Journ.*, Tokyo, June 1939, Vol. 3, No. 6, p. 143: Sept. 1939, No. 9, pp. 208–209.)

4794. ELECTRONIC ENGINEERING IN GEOPHYSICS [Seismic Method of Prospecting].—McCullough. (*Electronics*, Aug. 1939, Vol. 12, No. 8, pp. 28–30.)

4795. WHALING AND WIRELESS [Novel Use of Direction Finding: Description of Gear].—(*Wireless World*, 28th Sept. 1939, Vol. 45, pp. 301–302.) *See* also 2626 of June.

4796. AN ELECTRONIC CONTROL CIRCUIT [based on the Strobotron] FOR RESISTANCE WELDERS.—Gray & Breyer. (*Elec. Engineering*, July 1939, Vol. 58, No. 7, Transactions pp. 361–364.) For previous papers on the strobotron *see* 1787 of April.

4797. THE PRECISION CONTROL [of Voltage, R.P.M., or Output] OF LARGE POWERS BY MEANS OF IONIC TUBES.—Herzog & Vafiadis. (*E.T.Z.*, 3rd Aug. 1939, Vol. 60, No. 31, p. 934: long summary.)

4798. "THEORY AND APPLICATION OF ELECTRON TUBES" [Book Review].—Reich. (*Wireless Engineer*, June 1939, Vol. 16, No. 189, p. 286.)

4799. A RECORDING DEVICE FOR A SHOOK & SCRIVENER COLORIMETER [*e.g.* when used to Measure Rates of Reaction].—Miller. (*Review Scient. Instr.*, June 1939, Vol. 10, No. 6, p. 195.)

4800. THE ILLUMINATION DENSITY OF THE BLACK BODY AT THE TEMPERATURE OF SOLIDIFYING PLATINUM (PREPARATORY MEASUREMENTS FOR THE NEW UNIT OF LIGHT).—Willenberg. (*Physik. Zeitschr.*, 1st June 1939, Vol. 40, No. 11, pp. 389–394.)

4801. USE OF SELENIUM PHOTOCELLS FOR PRECISION PHOTOMETRY [Methods of eliminating Effects of Non-Linear Illumination/Reading Characteristic, and of Difference between Sensitivity Curve of Cell and of Average Eye].—Terrien. (*Comptes Rendus*, 31st July 1939, Vol. 209, No. 5, pp. 300–301.)

4802. ON A PHOTOMETER WITH SPHERICAL REVOLVING KNOB FOR OBJECTIVE MEASUREMENTS.—Vosinski. (*Journ. of Tech. Phys.* [in Russian], No. 4, Vol. 9, 1939, pp. 352–361.)

4803. PHOTOELECTRIC CONTROL [of Manufacturing Processes, etc: Survey].—Ott. (*Zeitschr. V.D.I.*, 29th July 1939, Vol. 83, No. 30, pp. 887–890.)

4804. AN EXAMPLE OF CONTROLLING A MACHINE-TOOL BY MEANS OF A PHOTOCELL [especially the Control of Multi-Motored Machines by a Single Photocell Unit combined with Several Thyratrons, by Variation of Intensity of Light Beam].—Mikami. (*Jap. Journ. of Eng. Abstracts*, Vol. 17, 1939, p. 58.)

4805. A METHOD OF DIMENSIONAL GAUGING WITH PHOTOELECTRIC CELL.—Tuttle & Bornemann. (*Electronics*, June 1939, Vol. 12, No. 6, p. 75: summary only.)

4806. AN OPACIMETER USED IN CHEMICAL ANALYSIS [based on Barrier-Layer Photocell].—Eavens & Silberstein. (*Electronics*, April 1939, Vol. 12, No. 4, p. 61: summary only.)

4807. MEASURING CHLOROPHYLL CONCENTRATION [Light-Ray Method using Thermocouple].—Johnston. (*Electronics*, March 1939, Vol. 12, No. 3, p. 62.)

4808. EFFECT OF TEMPERATURE ON THE NON-LOADED CARRIER CABLE [Frequencies 1–30 kc/s, 14-Quad Cable], *and* ON THE COMPLETION OF THE TYOSEN STRAIT NON-LOADED CABLE CIRCUIT.—Simizu & Miyamoto: Matsumae. (*Nippon Elec. Comm. Eng.*, May 1939, No. 16, pp. 596–599: pp. 620–627.)

4809. HEAT TRANSMISSION THROUGH THE ANODE OF AN X-RAY TUBE [Derivation of Solution for Temperature Field in Water-Cooled Half-Cylindrical Anode].—Nieukerke. (*Physica*, Aug. 1939, Vol. 6, No. 8, pp. 721–727: in English.)

4810. REPORT TO COMMISSION V ON RADIO PHYSICS [Non-Linear Oscillations, Electron Paths, etc.].—van der Pol. (*U.R.S.I. Proc. of 1938 Gen. Assembly*, Fasc. 1, Vol. 5, 1938, pp. 309–310.)

4811. "MITTEILUNGEN AUS DEM REICHSPOSTZENTRALAMT" [Vol. 20, 1938: Book Review].—(*E.T.Z.*, 3rd Aug. 1939, Vol. 60, No. 31, p. 943.)

4812. POSITION AND TRENDS OF DEVELOPMENT IN SWITZERLAND OF COMMUNICATION ENGINEERING [including Television].—(*Bull. Assoc. suisse des Élec.*, No. 18, Vol. 30, 1939, pp. 615–624.)

4813. THE TECHNICS OF WIRELESS WAVES AND THEIR BOUNDARIES [Lecture to Brunswick Technical College: including Many Photographs of Short- & Ultra-Short-Wave Aerial Systems].—Hahnemann. (*Lorenz Berichte*, June 1939, No. 1/2, pp. 4–36.)

Wireless Patents

A Summary of Recently Accepted Specifications

The following abstracts are prepared, with the permission of the Controller of H.M. Stationery Office, from Specifications obtainable at the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1/- each

AERIALS AND AERIAL SYSTEMS

508 579.—Motor-car aerial designed to offset the loss of strength due to low capacitance and high inductance.

G. W. Johnson (communicated by Philco Radio and Television Corporation). Application date 1st November, 1937.

508 777.—Motor-car rod aerial mounted on a swivel support, with means for raising or lowering it as required.

Daimler-Benz Akt. Convention date (Germany) 23rd March, 1938.

508 949.—Aerial input-coupling comprising transformers and a transmission-line protected by a common waterproof casing.

A. L. Disney and Belling and Lee. Application date 4th January, 1938.

509 729.—Wireless aerial fitted with a condenser " top " to minimize static disturbances.

G. de Monge. Application date 1st September, 1938.

DIRECTIONAL WIRELESS

507 894.—Marker beacons as used for radio-navigation.

Telefunken Co. Convention date (Germany) 28th January, 1938.

508 048.—Directive aerial comprising two tightly-coupled wires on which stationary waves of the same amplitude are built up with a phase displacement of 90°.

Marconi's W.T. Co. and O. Bohm. Application date 24th December, 1937.

508 139.—Direction-finder in which the " bearing line " is indicated by the intersection of two pairs of polar diagrams formed on the screen of a cathode-ray tube.

Telefunken Co. Convention date (Germany) 26th June, 1937.

509 731.—Direction-finder in which the pick-up from two dipoles, and two frame aerials, is combined in a cathode-ray tube to give an indication free from " night error."

Standard Telephones and Cables (assignees of Le Matérial Téléphonique). Convention date (France) 17th September, 1937.

RECEIVING CIRCUITS AND APPARATUS

(*See also under Television*)

507 839.—Frequency-changing method of increasing the signal-to-noise ratio in a wireless receiver.

The General Electric Co.; N.R. Bligh; and A. Bloch. Application date 21st October, 1937.

507 852.—Arrangement of the local-oscillator circuit of a superhet to facilitate automatic frequency control.

Marconi's W.T. Co. Convention date (U.S.A.), 21st December, 1936.

507 896.—Circuit adapted for receiving either amplitude- or frequency-modulated signals.

Telefunken Co. Convention date (Germany) 21st February, 1938.

507 948.—Tuning scale with fixed and moving parts for making vernier adjustments.

Murphy Radio and L. Fisher. Application date 15th February, 1938.

508 042.—Variable selectivity control in which, as the degree of coupling is varied in one direction, reaction is automatically varied in the opposite sense.

Telefunken Co. Convention date (Germany) 24th December, 1936.

508 304.—Tuning device in which any desired programme can be selected by a slight pressure with the finger-tip on a strip printed with the names of the available stations.

Marconi's W.T. Co. (assignees of E. N. Muller). Convention date (Luxembourg) 24th December, 1936.

508 462.—Variable-gain amplifier in which a screening grid is connected through a variable resistance to the grid nearest the cathode of the valve.

Philips' Lamp Co. Convention date (Holland) 8th January, 1938.

508 924.—Wireless receiver arranged for switch tuning, with means for adjusting the band-pass characteristics of the selective circuits.

Hazeltine Corporation (assignees of W. A. MacDonald). Convention date (U.S.A.) 21st October, 1937.

509 615.—Ultra-short-wave amplifier with concentric-line coupling-elements arranged in parallel.

Marconi's W.T. Co. (assignees of P. D. Zottu). Convention date (U.S.A.) 21st January, 1937.

509 509.—Push-button tuning system wherein one station after another can be selected without the operation of a " resetting " member.

Marconi's W.T. Co. and D. A. Bell. Application date 22nd January, 1938.

510 186.—Wedge arrangement for ensuring the accurate operation of a push-button tuning system.

Murphy Radio and A. Nield. Application date 4th February, 1938.

510 301.—Motor-car set in which the gain of the L. F. amplifier is made to vary inversely with the amplitude of the signal input.

Pye and M. V. Callendar. Application dates 2nd February and 22nd June, 1938.

TELEVISION CIRCUITS AND APPARATUS

FOR TRANSMISSION AND RECEPTION

507 779.—Balanced bridge circuit for controlling the magnetic fields used for focusing a beam of electrons in a cathode-ray tube.

The General Electric Co.; and L. A. W. E. Kemp. Application date 11th January, 1938.

507 840.—Arrangement of the "gun" and focusing electrodes of a cathode-ray tube.

F. H. Nicoll. Application date 19th November, 1937.

508 037.—Cathode-ray television receiver for reproducing pictures in natural colours.

Kolster-Brandes and C. N. Smyth. Application date 24th December, 1937.

508 038.—Secondary-emission valve for separating picture and synchronising impulses of opposite polarity in television.

Baird Television and E. V. Truefitt. Application date 24th December, 1937.

508 039.—Cathode-ray television receiver for reproducing pictures in natural colours.

Baird Television and J. L. Baird. Application date 24th December, 1937.

508 065.—Light-modulating device in which supersonic "compression" waves of different frequencies are utilised.

Scophony; J. Sieger; and F. Okolicsanyi. Application date 21st December, 1937.

508 076.—Television scanning system in which the spot of light is strengthened or weakened by the action of revolving spokes the speed of the latter being controlled by the incoming signals.

J. Leonard. Application date 23rd December, 1937.

508 391.—Iconoscope type of mosaic-cell screen provided with a semi-conductive backing to maintain the screen at a desired level of potential.

Marconi's W.T. Co. (assignees of H. A. Ians). Convention date (U.S.A.) 27th February, 1937.

508 712.—Cathode-ray tube of the kind in which the fluorescent or like screen is made rotatable.

Scophony and A. H. Rosenthal. Application date 18th January, 1938.

509 715.—Television receiver with a "supersonic" light-cell energised by compression waves produced by a piezo-electric crystal which is excited by a cathode-ray stream.

Scophony and F. Okolicsanyi. Application date 21st January, 1938.

509 766.—Television receiver using a supersonic light-cell combined with means for "immobilising" the compression waves relatively to the cathode-ray screen, in order to intensify the picture.

Scophony and A. H. Rosenthal. Application dates range from the 18th January to 12th July, 1938.

509 831.—Synchronising system for interlaced scanning wherein a definite "lag" is introduced in order to ensure accurate interlineation.

Radio-Akt. D. S. Loewe. Convention date (Germany) 20th January, 1937.

TRANSMITTING CIRCUITS AND APPARATUS

(*See also under Television*)

510 226.—Ultra-short-wave oscillator with a back-coupling circuit of coaxial conductors.

Telefunken Co. Convention date (Germany) 5th February, 1938.

510 512.—Frequency-determining "resonator" and generator, or amplifier, for ultra-short waves.

O. Bormann (J. Pintsch Akt). Convention date (Germany) 4th November, 1936.

510 639.—Split-anode magnetron valve for generating or detecting ultra-short waves.

Marconi's W.T. Co. (assignees of R. A. Braden). Convention date (U.S.A.) 24th July, 1937.

510 763.—Modulating ultra-short waves by utilising variable-mu valves arranged in push-pull.

Soc. Francaise Radio-Electrique. Convention date (France) 15th September, 1937.

CONSTRUCTION OF ELECTRONIC-DISCHARGE DEVICES

508 778.—Electron discharge device with a secondary-emission electrode which is arranged "out of sight" of the primary cathode, and artificially cooled.

Philips' Lamp Co. Convention date (Germany) 25th March, 1938.

508 853.—Thermionic valve construction designed to increase the number of electrodes which can be fitted in a given space.

E.Y. Robinson and Metropolitan-Vickers Electrical Co. Application date 4th January, 1938.

510 232.—Arrangement and spacing of the grid, cathode, and secondary-emission or target electrodes in an electron-multiplier.

The Mullard Radio Valve Co. Convention date (Germany) 9th May, 1938.

510 592.—Arrangement of the cathode, electron-permeable anode, and target electrodes in an electron-multiplier.

Radio-Akt. D. S. Loewe. Convention date (Germany) 3rd November, 1936.

510 712.—Electrode construction and mounting for a thermionic valve, designed to be proof against shock and vibration.

Standard Telephones and Cables and D. H. Black. Application date 4th February, 1938.

SUBSIDIARY APPARATUS AND MATERIALS

508 297.—Variable Lecher-wire coupling for use with ultra-short waves.

Telefunken Co. Convention date (Germany) 10th February, 1938.

508 458.—Loud-speaker installation, located below ground-level, for a public address system.

Telefunken Co. Convention date (Germany) 10th November, 1937.

509 779.—Holder for a piezo-electric crystal-oscillator designed to give a purely "cord" suspension.

Marconi's W.T. Co.; D. H. C. Scholes; and D. Fairweather. Application date 20th January, 1938.

509 922.—Thermionic relay controlled by capacity changes, e.g., by the approach of a person towards a protected area or object.

J. Cochrane. Application date 21st October, 1937.

510 098.—Apparatus for testing valves with from four to nine pins and with different pin-to-electrode connections.

J. F. Everett and The Automatic Coil Winder and Electrical Equipment Co. Application date 2nd February, 1938.